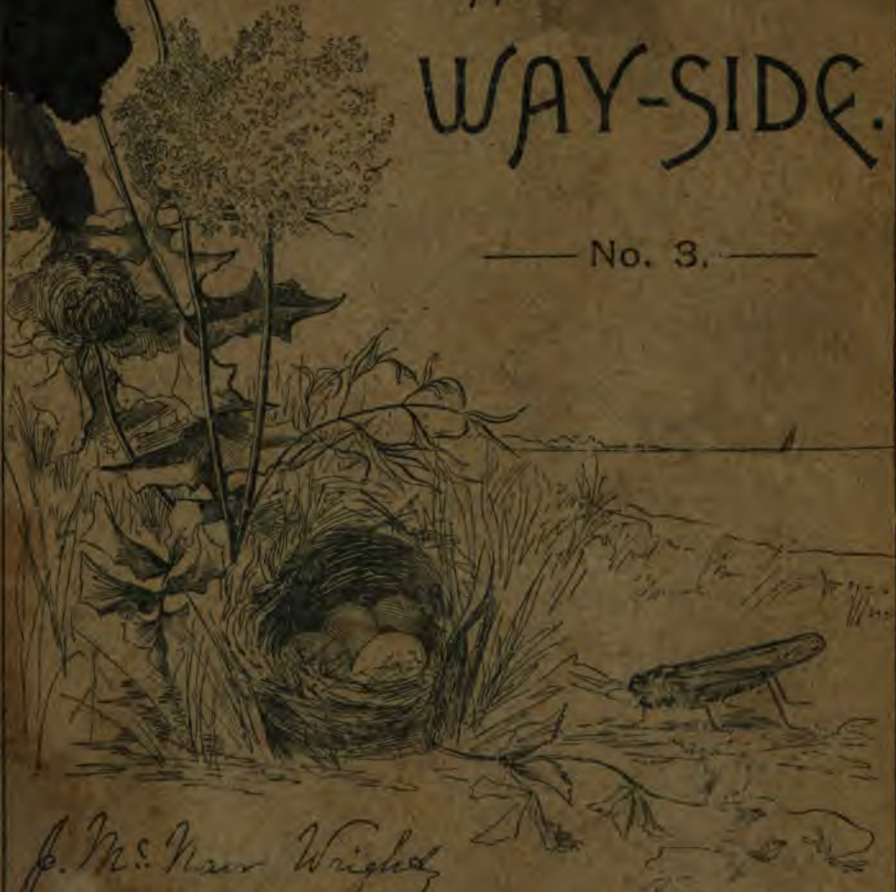
NATURE READERS.

SEA-SIDE AND WAY-SIDE.

No. 3.



J. McNair Wright

D. C. HEATH & CO., Publishers, BOSTON.

FRONTISPIECE

Nature Readers.

SEA-SIDE AND WAY-SIDE.

No. 3.

BY

JULIA McNAIR WRIGHT.

"And if ever the way grew long,
  And his strength began to fail,
She sang a more beautiful song,
  And she told a more wonderful tale."
LONGFELLOW'S "*Birthday Poem to Agassiz.*"

Illustrated by C. S. King.

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PREFACE.

In presenting a third volume of the Nature Readers to the children of our land, and to their parents and teachers, I feel it both a duty and a delight to thank those who have so cordially and sympathetically welcomed a new departure in School-Book Literature.

I have not sought to model these Readers upon any pattern previously set, but to make them the outcome of what I have learned, by observation, of the receptive and retentive powers of children.

I desired to impart useful and needful knowledge, in a fashion which should not be burdensome, and which should strongly impress young minds.

I have had no hobby of book-making, nor of style to follow. My one idea has been to benefit the child, and to that end I have directed my whole effort.

I sing an old song when I say, that we are a nervous race, and our children are more intensely nervous than their parents. The antidote for this nervousness, and its consequent train of disasters, is to be found in the open air, in healthful out-of-door exercise, in the serene calm of nature, in the peaceful joys which the investigation of nature affords us.

If we can open wide the gates of "the fairy-land of science," — if we can bring the child near to the heart of nature, — if we can absorb his hours of leisure, and many of his hours of brain-work, in the study of nature out of doors, we shall have done much toward making him robust in body, sound in mind, cheerful of disposition, and useful in the future.

THE AUTHOR.

TO THE BOYS AND GIRLS.

ONCE more we are going out together by the Sea-side and the Way-side. We shall now learn more of our Great Mother, the Earth, and of her many children.

Once I read a tale of a queen, who gave all that she had to her youngest son, and ordered all his brothers and sisters to be his servants. I did not think that that was fair.

But something very like this has happened to us in this world. We human beings are the last and youngest of living things, and yet all the rest serve us, and are for our use. In this book I shall tell you the secret of this. I shall tell you of the flowers and trees; they are the earth's eldest children. I shall tell you how they have taken insects and birds for their partners, and have gone into business, to feed the world.

We shall look at those pretty partners in their work and play.

The birds have some lovely stories to tell us in their songs.

And then, we shall put on some new spectacles, and look into the brooks, and ponds, and into the rivers

and seas, and see the Fin Family, which feel so safe, hiding deep down in the waters.

And when you have learned a little of the wonderful way in which all the parts of the world fit together, and work together, I want you to think how wise and good is the great God who made all.

J. M. N. W.

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"NOTHING LEFT HIM."

SEA-SIDE AND WAY-SIDE.

LESSON I.

THE GREAT MOTHER.

"WHAT are you doing?" I asked a boy to-day.
"Only digging in the dirt," he said.
"And what is that in your little cart?"
"Nothing but dirt."
"And what is this that you call dirt?"
He did not reply. An older boy, who had read more, said: "Dirt is the top crust of the ball, called the earth, on which we live."

"Very good. Now, my lad, what is dirt worth?"

The boy who was digging said: "Ho! Dirt is worth nothing."

"Suppose that I could take away from you all that you get from the earth. What would you have left?"

"Many things," said the little boy.

"Well," said the older boy, "we should have no fruit, nor vegetables, for these come from the ground. We should have no bread. Wheat grows from the ground. No sugar, for sugar is made of beets and sugar-cane."

"And," I said, "you would have no milk, butter, or cheese. For the cows must eat grass and other plants, from which to make milk."

"That is so," said the big boy. "And, since it is so, you may say we should have no meat. The animals must eat plants, of some kind, or they could not live and grow."

The boy who was digging now looked at the dirt with more respect.

"So you would lose all your food. For food is animal or vegetable, and so comes from the dirt. Let us see about your clothes. You would lose all cotton and linen clothes. For cotton and flax grow out of the ground. You would lose all silk, woollen,

and leather, clothes. The silk-worms, sheep, and other animals feed on plants that grow in the dirt. You must lose your straw hats also. Straw is the stem of a plant."

"I should have my house," said the boy who was digging.

"Let us see about that. Your house is made of stone, brick, or wood, plaster, paint. All these things come from the earth. Bricks are clay, burned. Wood grew in the ground as trees. Plaster is lime, sand, and so on; these come from the earth. The paint is made of oil and ground minerals. We get these minerals from the earth. If I could take from you all you have from the earth, you would have no house, nor food, nor clothes. You must go and sit out-of-doors, in a very sad state."

"At least," said the boy, "I should have my little iron shovel, and my little iron cart."

"No, you would not," said the big boy. "Iron is dug out of the earth. You would have no stove, no knives, no such things as pots, and pans, to cook in! Ha! ha! ha!"

"I have a box full of pennies," said the small boy, "and dimes, and gold dollars; I would buy more things."

"All your money will be gone with the rest of your

losses. The pennies, dimes, dollars, are made of metals. Metals come from rocks that are found in the earth," I said. "Also, all the dishes in your house are made of clay and metal. You would have to lose them. All your furniture is of wood, metal, and leather, you would have to lose that. But you would soon starve without food. So it makes little matter what else you lose."

"I should sit on the sea-shore, and catch fish to eat!" cried the small boy.

"You must then catch them without hook, net, or line. But let us begin on the fish, and take away all that feed on sea plants. Next let us take away all that feed on fish that have fed on plant-life. Soon you will be in a sad way for fish to catch."

"So all that we have comes from the earth?"

"Yes. The earth is a great treasure box, out of which come all things which we see about us. It is for this reason that we say, 'Mother Earth.' In old times people said the earth was the great mother of all things. So do not speak with scorn of that dirt, which is 'the earth's top-crust.' What would you *have* without it?

"What would you *be* without it? Your flesh, blood, bones, are built up of what you eat and drink. If all the things that come out of the earth were taken from you, you would soon perish.

"Just now you found that you would have no house to live in, and no clothes to wear. So, soon your mind and soul would have no body-house to live in; no flesh-clothes to wear. Every part of you, except the mind and soul part, comes from the earth.

"When we look at the earth that which we first notice is the plant, or vegetable. By plants we mean the trees, grasses, and other things, which grow out of the soil. Plants are Mother Earth's first children.

"Beside the plants which grow in the soil, there are plants which are called air-plants, because they grow in the air. Also there are plants which grow in water. These are called water, or aquatic plants."

We will now have some lessons on plant-life.

LESSON II.

THE EARTH'S ELDEST CHILD.

PERHAPS you have looked at the books of some of the elder pupils in your school. Did you see one marked "*Botany*"? Did you see in it pictures of flowers, and parts of flowers? Botany is the study of plants.

These lessons in your Nature Reader are not to teach you botany. They are only to tell you some of the curious things about plants. When you read these lessons, you will like plants, not only because they are so very pretty and useful, but because of the wonders of the plant-world.

I shall tell you some of the secrets of the wonder-world of plants. Then I hope you will wish to find out more of the secrets for yourselves.

I once asked Tom, "What is a plant?"

"A plant!" cried Tom, "oh, a plant is — a potato, a turnip;" and off he went, quite satisfied with his answer.

He was content, because he knew so little. If he had known more, his answer would not have suited him so well.

You will get a peep at the wonders of plant-life from this little story. I said to a class of girls, who had studied botany for a year: "What is a plant? I will give you half an hour to find an answer that will suit you."

One girl said in a hurry: "A plant is not a living thing!"

"O you silly girl!" cried all the rest. "A plant grows. Only living things can grow. Why do you say 'a living tree,' and 'a dead tree,' if plants are not

living things? Did you never see a plant dying or dead?"

"A plant," said another, "is a living thing that does not breathe."

"Oh, but it does breathe. It breathes air."

"A plant is a living thing that eats only minerals."

"Ah! but some plants eat little bugs, and meat."

"A plant is a living thing that does not move."

"It does move! Does not the vine climb up the tree, or by the side of the house? Do not some flowers turn each day to follow the path of the sun? Does not the wild ivy run over the ground? Then there is a plant in the desert that moves to find water. It gets loose from the sand. It bends up into a circle or wheel. Then the wind rolls it along, until it reaches a moist place where it can live. There it roots again."

"A plant is a living thing without blood."

"Its sap, or juice, is its blood. It serves the plant as blood serves man. The sap is as much the blood of the plant as the white fluid in the jelly-fish, the insect, or the barnacle, is blood for them.[1] All animals do not have thick, red blood."

"A plant is a thing that does not sleep" said one girl.

[1] See Nature Reader, No. 2, on these subjects.

"Yes, but plants *do* sleep. We learned that once."

"A plant is a living thing, without feelings."

"Some of them seem to have feeling. They move or shrink when you touch them. A star-fish, as he breaks himself up, does not seem to have more feeling than a plant."

"Let us say," said one, "that a plant is a live thing, that grows in the soil."

"But there are plants that grow only in air, or in water, or in other plants. There are plenty of plants that grow in bread, cheese, milk, and preserves."[1]

Finally they said: "A plant is a living thing, generally rooted in the earth, and growing from a seed, or something like a seed. A plant has no brain, and no nerves."

Their teacher told them that the great point about a plant is, that the plant eats minerals and turns them into other substances. Animals get most of the mineral food that they eat from the plants, after the plants have made it over.

Now, from what this class said, you have learned some of the curious things about plants. Plants live, breathe, grow, move, eat, drink, and sleep.

[1] That which we call *mould* upon such substances is a form of vegetable life.

More than this, I shall show you how plants serve for clocks. Plants also can tell you about the weather, whether it will be wet or dry.

And the plants have gone into business, and have partners. The birds and insects are the plant's partners. The plants live, and grow, and go into business, just to make other plants. But the end of the business is, that the world is fed.

Do you now think that you should like to learn about plants? Here are a few facts to begin with.

Plants are so different in size that they are among the largest and the smallest things in the world. The great trees in California are so large that a hundred people can stand upon one stump. They are as tall as the tallest towers in the world. Twenty men on horses can ride into the hollow of one tree. Other very great trees are found in other parts of the world.[1] The largest trees are in Australia and California.

In other places there are also very big trees. In New Jersey I once saw a large, hollow tree, in which a goat lived. He was a big goat. He jumped about and slept inside the tree. When the children called him he came out to draw their cart. In another hollow tree I saw a very nice play-house.

While some plants are so large, others are very small.

[1] The oldest and largest known tree is a chestnut at the foot of Mount Etna. The trunk is 212 feet in girth.

There is a little pond weed, which, root and all, is not so big as a grain of rice. Other plants are as small as pin heads. Others are so small that you cannot see them without a microscope.

Plants differ as much in age as in size. Some grow and die in a few hours, or a day. Others live only a year. Some trees are said to live three thousand years.

There are plants that have flowers, and plants that never have any flowers. There are plants that grow from the outside in, other plants grow from the inside out.[1] If you like plants, and some day study Botany, you will find out about all these things.

LESSON III.

A LOOK AT A PLANT.

PLANTS are divided into two great classes. One class contains all plants with flowers. The other class contains plants that have no flowers. The plants with flowers are the ones which you like best. They are of the most interest to you. Besides this, they are the easiest to learn about.

[1] Gray's "How Plants Grow," pp. 41, 42, will here aid the teacher.

A piece of moss is a flowerless plant. What you call a "simple bit of moss," would be harder to learn about than a whole garden full of lilies and roses.

The plants with flowers are the most perfect plants. They are also the most beautiful, and the most useful. A perfect plant has six parts for you to notice: 1, the root; 2, the stem; 3, leaves; 4, blossoms (the blossom is made of several parts); 5, a bag or box for seeds; 6, seeds.

A CHILD OF THE GARDEN.

Here are all those parts shown in our picture of a pea-vine. You see our pea-vine has something else. It has little curly things with which to climb. They are its hands for taking hold of objects. They are leaves, buds, or twigs, that have changed. They are now tendrils. They grew slim, and long, and curly, as the plant had need of them for climbing.

Some plants do not have all these parts. Some have no stems. Have you not found little plants without stems? The leaves and flowers sit close upon the earth. Some plants have no leaves.

Sometimes parts of the flower are gone. Instead of a fine flower there may be only a little scale, with a bunch of small threads lying upon it.

Now let us take a little look at the parts of a perfect plant. We just want to see the great variety in them. We will learn also of what use they are to the plant.

Of what use are roots? The root is the plant's anchor to hold it firm in its place. The root is the plant's pantry or cellar, where much of its food is stored up. The root is the plant's mouth. Many of the mouths of the plant are on the ends of the little fibres that grow from the main part of the root. Get some plant roots and look at the fringe-

like, slender fibres. These little mouths under ground are eating, eating, eating, all the time. They eat all kinds of minerals held in water in the earth.

Roots last one, two, or many years. Where the root lasts one year, the plant is soft and juicy. Where the root lasts over one year, the plant is often more or less hard and woody.

Roots differ much in shape. Pull up some grass. That has roots like a bunch of coarse threads. When I was a child I was much pleased to learn that it was such slim, thread-like roots that held together the earth of the Holland coast, so the sea could not wash it away.

Get a carrot from the garden or market. What a long wedge-like root it has. The radish is a slimmer root. The beet has the same general shape, but is thicker. The turnip is round. The dahlia has rough, knobby roots of many shapes.

But, in fact, all these thick parts which we call roots are not true roots. The real true roots are the little fibres with mouths at the ends. These thick, round, wedge-shaped, or knobby, parts, are stems, or parts of stems, that grow under ground.

Now and then, if a tree or plant is set in the earth, top down, the roots will put out leaves and buds.

This shows that they are underground stems, or branches.

"What kind of a root is a potato?" asks Bobby. A potato is not a root. It is a thick underground stem. The real potato roots are the little fibres.

"What kind of root is an onion?" says Mary. An onion is not a root, it is a bud or bulb. The scales are leaves that have grown white and thick. The real roots of the onion are the fibres that hang in a bunch under the round part.

Roots are of many colors. They are brown, white, red, yellow, pink, orange.

Roots of many plants are useful to men for food. They also have stored up in them the food on which the plant lives.

Now let us look at the plant stem. See this lily stem. It dies down each year. It is soft and hollow, and full of water. Cut down a rose stem. That lives a number of years. It is hard and woody.

Some stems have leaves growing upon them, some have none. Some are smooth, others are jointed. Have you seen the joints or rings on a corn-stalk?

Some stems are erect, as the trunks of trees. Some stems climb, as that of the vine; some creep along the ground, as those of the strawberry.

Some stems are round, some square; some are smooth; some are rough.

The color of most stems is green, or brown. Sometimes they are yellow, or of other colors. The corn stem is pale yellow. It has joints. From some of these lower joints you will see roots growing out, and reaching down to fasten in the ground. They act as tent cords; they help hold the stalk firm in the earth.

The trunk of a great tree is a stem; so is the fine stalk of a violet. You see how they differ in size. But different kinds of stems have different names.

Of what use are stems? To the plant the stem is of use, as it holds the leaves, and flowers, and fruit, up into the air and sun. Also the stem is made up of the tubes or pipes which carry the sap, and the food it holds, through all the plant.

Plant stems are very useful to men. The stems of trees give us wood for fuel, and to build ships and houses, and to make furniture. Some stems are also good for food. The stems of flax give us linen.

Now let us look at leaves. What can you tell me about leaves? You will say they are mostly green, but some are of other colors. You will tell me that some are thick, some are thin. Some have veins like a net, some have straight veins. Some leaves are smooth, some rough, or downy.

Some leaves are long, like those of the yellow lily; some are round, like those of the water lily. Some are shaped like hearts, some like arrows, some like shields. Some have smooth edges, some have edges pointed or scalloped. Suppose you count and see how many kinds of leaves you find?

Of what use are leaves? By the leaves the plant breathes. But I shall tell you more about the use of leaves to the plant some other time. Leaves are of use to man. They make a lovely shade. Some leaves are good for food. Out of some leaves cloth, hats, and other useful things, are made.

Leaves differ much in size. There are big palm leaves, ten feet wide. Other leaves are as small as a grain of rice.

Most leaves die and drop from the trees in the fall of the year. But some leaves stay green all winter.

The part of the plant which you like best is the flower. The flower has the most of the color, and the most of the fragrance of the plant. In the flower cup is that drop of honey which the insects like.

Let us look at a buttercup flower. First, here is a ring of what you call five green leaves. They form a cup to hold the flower. Next to these you

find a row of bright yellow leaves. These are the petals. Inside there is a little bunch of fine fringe. This fringe is of two kinds. The outside threads are stamens, the middle ones pistils.

The stamens have on them the pollen, or yellow dust, of which you have heard.[1] At the bottom of the pistil is the little seed case or bag. This case grows. It holds the seeds. The other parts of the flower fade and fall. The seed case grows and grows, and the seeds grow in it.

The seed cup, or case, is of many shapes and sizes. I shall tell you more of the seed and its case some other time.

Flowers differ as much or more than leaves in shape, color, size. They differ also in smell. Some smell sweet; some smell bad; some have no smell. Sometimes the flower cup is all in one piece, sometimes it is in two, three, five, or very many pieces.

LESSON IV.

A YEAR IN A PLANT'S LIFE.

Now you shall hear the story of a plant's life. The life-story I shall tell you is of a plant that lives

[1] Nature Reader, No. 2, pp. 34, 35; No. 1, pp. 39, 45.

one year. This story begins with a seed and ends with a seed.

The story of any plant would be this, only that the story of some plant-lives would run through many years. During these years they would ripen many crops of seeds.

Let us take the story of a bean's life. We choose this because a bean has a plain and simple story. All its parts are large enough to see. Any one of you can get beans to help tell the story.

To enjoy this story you should get a bowl, or pot, of earth, and seven beans. Now first look closely at these beans. They have a thick shining skin. Break open one bean. It is made in two halves, which have a little seam around them longwise. On the middle of one side is a dent. Your mother will tell you that is the *bean's eye.* This dent goes through the outer skin.

Now soak your other six beans in water for a few hours. If you soak them they will sprout sooner when you plant them. Now put one bean in the middle of the pot, or bowl, of earth, and the other five around the sides. Do not bury them too deep. Let about half an inch of earth lie over them. Keep the earth moist. Set the pot in the sun and in fresh, but not too cold, air.

When you took your beans to plant, did they look just as when you put them in the water? No. They were swollen with the water, and the skin was wrinkled. You could see the seam around the bean, and the eye, much plainer than when the bean was dry.

In a day or two you may dig up one bean from the edge of the pot. Now you will see a small round thing, shaped a little like your lead-pencil point, coming out of the eye of the bean.

Take a needle and gently split the bean open. The upper end of this tiny stem is bent over, and has a little wrinkled knob on it.

In another day you may dig up a second bean. Split it; you will see quite plainly that the wrinkled knob is a pair of leaves, and the round object is a stem.

Wait a day or two more and dig up the third bean. The stem is putting out wee roots. The leaves have come out of the bean and are trying to get to the top of the earth. The two thick halves of your bean are held, by little thread-like stems, to the main stalk of the new plant. The skin that was on the bean is now a small dry husk.

In a few days your fourth bean will be well above ground. You will notice that the two thick halves of the bean you planted are now turning

green, and look like thick leaves. At first they lay side by side. The skin was like a little cap over the ends of the two.

Perhaps in that state the bean made you think of a new chick just out of the shell, with a piece of the shell still on its head. Did you ever see that? Soon the bit of husk falls away. Then these two parts of the bean spread from each other. One is on one side the stem, one on the other.

They look like leaves. We call them "the seed-leaves." You will see that as the plant grows, these shrink up. That is because the young plant is feeding on them. The thick part of the bean is the plant's first food.

The bean which you put in the middle of the pot has gone through all these changes. Its two little wrinkled leaves become greener and larger. Now they show their deep green color, and are of a heart shape. They have long stems. Between these stems is a little bud, or growing-point. It shoots up and puts out more leaves.

By this time the thick seed-leaves are quite shrunk up and dead. Dig up that fifth bean, the last one on the side of the pot. Can you tell why the seed-leaves are dead? The plant has eaten up all the food in them. And now it has a strong root of fibres, and can take its own food from the soil.

If you look near the roots of trees in the wood or garden, you will, no doubt, find oaks, cherries, maples, other little trees, in all these stages of growth.

Your last bean-plant grows fast. It is tall and slim. It needs a stick to climb on. Notice how the stem winds around the stick. See, the new leaves are pale and smooth. As they grow, they become darker and have hairs on them.

Break off a bit of stem and leaf. There is juice in them. That is sap. It runs all through the plant in little pipes or tubes. It carries in it the mineral food the root-mouths suck from the earth.

By and by you will see a new thing in among the leaves. It is a bud, but not a leaf-bud. It is shorter and thicker than the leaf-buds, and it is twisted. As it grows, its green cover opens, and you see a little white, red, or purple color.

This is the flower-bud. Slowly the colored petals unroll. If you have several flowers on your vine, you can take one to pieces, to look at all the flower parts. The seed-bag at the bottom of the pistil will be so small that you will not notice it.

As the flowers grow older and seem to fade a little, cut off one more to look at. Now you see the seed-pod growing at the bottom of the pistil. The pistil is made of three parts; the seed-bag, the stem or post, and a little cushion at the top.

Now your pretty bean-flower has faded, and fallen away, dead. But what is this where the flower was? A little sharp, green thing is here! Why, it is a tiny bean-pod! Every day it grows larger. You can see the little beans through the skin of the pod.

By and by the pod has its full growth. It is brown and hard and dry. It will crack open easily. It cracks all around into two halves. Here are the beans fastened to the sides of the pod, by little thread-like stems. Just such beans as you planted in the spring!

All the spring and the summer your bean-plant grew. Now it is done growing. The cold autumn has come. The seed is ripe.

But what is the matter with your bean-plant? It is turning hard and brown and dry. It is dead. It will do no good to water it. Its roots drink no more; they are dead. It was made to grow only from spring to fall. From seed to seed, that is its story; that is what it was made for.

Here, folded up in these hard dry beans lie the bean-vines of next year. These new beans will have, if you plant them, such a life-story as this that we have been reading.

IN SUN AND DEW.

LESSON V.

THE GROWTH OF PLANTS.

How do plants grow? That is a very great question, but we will try to find a little part of the answer.

You know when you look at a flower, as a lily, you find in the middle of it some tall, slender parts which you are told are stamens and a pistil. The pistil usually stands right in the centre of the flower. It seems to be the most precious part, and all the other parts take care of it.

I knew a boy who told his sister that "they said at school that plants had little guns." He thought the word pistil meant something to shoot with! But if there is any shooting done by plants, it is done by the stamens, and not by the pistil.

On the top of the stamen is a little box, to hold the pollen, or flower-dust. You read of that some time ago in the lesson about bees and ants, in your other Nature Readers.

When the pollen is of full size, or ripe, the little box bursts open, and out the pollen flies. The growth of the plant begins here, with the pollen.

A tiny grain of pollen, falling on the top of the pistil, begins to grow. It puts out little threads like roots. These grow down the stem, or post, of the pistil into the seed case. There they find the seed germs, and when the pollen comes to them, the germs begin to grow. They grow very fast.

It is then that the pretty flowers fade. The work of the blossom is done when the pollen is ripe, and the seed germs begin to grow.

But while the blossom dies, the seed bag grows larger and larger. As the seeds ripen, the bag, or case, that holds them becomes brittle. It will break easily. Often this pod, or seed bag, bursts open when the seeds are ripe. Then the seeds fly all around.

They fall upon the ground. There with the wind and rain and the slight change of the top soil, they slowly sink into the dirt. They keep moist and warm until spring. Then they sprout out as you see the beans do.

Some seeds will die if left to lie all winter in the ground. We say such seeds are not hardy. They are seeds that are not native to the place where they grow. Seeds are hardy in their native places.

Now you have seen how the seed germ grows to be a ripe seed. You have seen how the ripe seed sprouts into a plant. You know that plants grow. They increase in size. They put out more leaves. They have flowers and seeds. How is this done? It cannot all be explained, but a little of it can be.

Look at yourself. You grow. Suppose you did not eat? Would you grow? If you stop eating you will shrink up, and be thin, and even die. Have you never heard people say that if children do not have enough to eat, they will be small and not grow well?

You grow by eating. So does the plant. But mind you, when we speak of the plant as eating, we mean really *drinking*. The food the plant takes from the earth must come to it in a liquid form.

You know of some insects which take their food by sucking the juice out of things.[1] So the plants get their mineral food, held in water. They suck the water out of the ground, by the wee mouths at the tips of the root fibres.

You know, when it is very dry the plants droop. People say "it is so dry that the crops will not grow." Even the leaves of the trees die and fall off in a very dry time. They die for lack of food-drink.

You have a stomach where the food that you get is so changed that it will make for you good blood. The blood feeds and builds up every part of your body. The plant has no stomach, but its leaves serve it for the same purpose.

In the leaves the plant food is turned into stuff like the plant. But how does the food pass into the leaves? See the tall tree! How does the plant food go from the roots to the top-most leaves? It runs up little pipes or cells.

Plant stems are made of bundles of these tiny pipes. Do you now fancy long slim pipes, as long as the stem or trunk of a tree? Dear me, no! These tubes are very short.

But the bundles of them are laid along, all up the stem. They are laid end to end. Or you may call it one

[1] Nature Reader, No. 1, pp. 29, 65.

long tube, with little walls, or partitions across. How does the sap pass through these walls? It would be very hard to tell.

What we know is, that it does go through very quickly. Take a flower with a clear green stem. Put it into a glass of water in which is some red or blue color. You can watch the rise of the colored water by the change in the color of the stem.

Take, in your garden or flower-pot, a plant that is dry and drooping. Pour water on it. Soak the earth about it well. In a very little time you will see the plant revive. The leaves will look fresh. The flowers will hold up their drooping heads.

I have seen a plant quite changed in this way, in half an hour. So you see, in this little time the roots drank the water from the earth. The water, as sap, ran up all the pipes, through all the partition walls. The flower was fed in every part.

When the plant is young and tender, it takes in much of its food through the whole surface or skin. It drinks in air, rain, and dew, through its skin. But as the plant gets older, and harder, it feeds more and more by the new roots and young leaves. At last, it takes almost all its food by the root and new leaves. I shall soon tell you what leaves eat.

Why then does any plant or tree look so much better

for a good washing? One reason is that the dust is washed off. Then the pores, or little holes in the skin, are free and open. The plant can breathe through all its skin.

Do not forget that. Your skin is also full of little pores. They need to be kept open by plenty of washing.

Let us go back to those little root-mouths. When they drink water, they get some solid stuff. Every drop of water has a mite of mineral in it. It is this solid matter that makes plant fibre. It is this that is left as ashes when you burn a plant, or bit of wood.

The juice of plants is called *sap*. When the root drinks the water from the earth, it travels up through the pipes, through all the cell-wells. So it soon reaches the leaves. What do the leaves do with it?

The leaves, having a wide surface, spread out the sap to the light and air. The heat of the sun cooks the sap. That is, it sets free, in a sort of steam, the clear water. The solid parts of the sap are left.

You know that things are made thicker by cooking. Does not the molasses become thicker when you cook it for candy?

When the sap is made thicker it is like glue. But it is still very thin glue. Also the light and air and heat change the sap in other ways of which I cannot now tell you.

But the sap, being changed in the leaf, is now true plant stuff. It must travel through the plant to build it up.

It is only in the green parts of the plant that the sap is changed to true plant material. What was at first mineral, held in water and air, is now vegetable, or plant matter. Now you see why a plant must have air and light, or it will not grow.

Now that it is fit for plant food, the sap sets out to run through all the plant. It must go to every part to build all up.

There are not two sets of tubes, one for raw and one for cooked sap. All must run through the same cells. So you see, the sap will be mixed. The raw sap going up has some food sap in it. The food sap runs about with some raw sap mixed with it.

Yet, after all, each kind reaches the right place. All the raw sap is cooked, all the food sap builds the plant. Here it builds root, there leaf, there stem, there flower, or seed.

Did you ever notice how fast a plant will grow? Choose out some flower or weed. Watch it. See

how the tiny stem becomes tall and stout. See how the little leaves grow large and thick. A sunflower is a fine plant to watch in this way.

LESSON VI.

THE FOOD OF PLANTS.

You saw how in the bean a deal of food had been stored up for the young plant. So in the tuber of the potato, and the seed of corn, food is stored up. This food is stored up so that the young plant can grow in the dark, before it gets to air and light. Also it can grow before its root-mouths are able to drink for it.

The food so stored up is mostly starch. It is much such starch as your mother uses for the clothes.

Starch so laid up in the plant can turn sweet and change to sugar. The beet root has much sugar in it. A pea has sugar in it. So has corn. In the sugar-cane there is so much sugar that the cane tastes very sweet when you chew it. The sap of one kind of maple tree has much sugar in it. Did you ever boil down maple sap to sugar?

In some thick plants, like the cactus, much food stuff

stays in the stems. Usually it goes to all parts of the plant. The leaves, as the thinnest parts, keep the least. In the beet, carrot, potato, and others, much food is stored in what we call the root. This becomes a cellar or pantry, full of laid-up food.

As the food goes about the plant to build it, the little pipes or cells growing larger divide off into other cells. They set up new walls. The plant becomes larger as its cells increase. We will not try to explain this further to you. You might think it dull.

Perhaps you would like to know what it is that the plant drinks out of the soil?

The dirt — as you call the "top-crust" of the earth — is made partly of mineral matter. Men and animals cannot eat mineral matter. But the sap carries this to the leaves. It is not in a solid but in a liquid form. Every leaf is a little kitchen where, with the sun for a fire, the earthy stuff is cooked and changed into vegetables.[1]

Now they are good food for animals. The minerals carried in grass and clover are eaten by the ox and the cow, and so are turned into good beef and milk. The wheat is partly made of mineral

[1] This process is not only a cooking by heat, but the rays of light cause chemical changes which cannot be explained in a book like this.

substances changed to plant stuff. Wheat is made into bread. The bread feeds boys and girls.

So the beef and butter that were grass and, before that earthy matter, and the wheat that was once partly mineral, turns at last into rosy flesh and blood for you who read this lesson. Well! Well! There are many wonders in this world!

If all plants liked and used the same food, our food would be too much of one kind. But as plants eat many kinds of minerals, through them we receive material to build all parts of our bodies. We need lime for our bones. We need sugar. We need salt in our bodies. Plants eat from the soil lime, salt, chalk, iron, and many other minerals.

Suppose you go into the country. Why, here is corn in this field! Last year clover was here! You say to the farmer: "Why do you change things in this way? Why does not your wheat grow where it grew last year?"

"Oh," says the farmer, "my crops will not grow every year in the same place. Next year I shall have this corn-field put down in grass for a while."

"But why, why, Mr. Farmer? Why not have the grass-field always the grass-field? Why not have the wheat-field always in wheat?"

"It is because each plant has some chief kind of mineral food that it needs most. It takes more of that kind out of the ground. After a time it eats up all of that sort of mineral that is within reach of its roots in one field. Then the crop must be grown in a new place, out of which the mineral has not been eaten.

"By and by the sun, rain, frost, acting on the ground, bring up more of the kind of mineral that was used. In the meantime some other plant that needs more of something else will grow in that field.

"So, after a time, the wheat, or corn, can be planted in its old field again. But if crops grow year after year in the same field they will be sickly for lack of food.

"New, rich earth that has never been tilled, will feed the same crops many years."

While we are in the country, let us look around at what the farmer does. Here he brings cart-loads of stuff from the stables. He scatters it over his fields. Here he brings barrels of a kind of dust. He puts that too over the ground.

"O, Mr. Farmer, what are you doing now?"

"I am putting food on the ground for my crops." The plants have eaten much of the food from the

earth. These things contain more of the same kind of food.

Men have studied plants until they know what each kind needs to eat. They put this kind of food on the ground and it is carried to the plant by means of water.

What are these things that the farmer puts on his field? Bones are ground into bone dust. Fish are also ground into a powder or dust. Shells and sea-weeds and lime are scattered over the ground. Dead horses and other animals buried in what is called a muck heap, until they are decayed and fall into pieces, are among the material that the farmer brings to enrich the soil.

Do you not see that all this food would be of no use to the plant were it not for the green leaves? The green leaves turn the raw sap into food for plants and men.

The green leaves also take other things from the air and build them up into plant stuff. Our breath, the smoke from our fires, become food for plants, and so food for men. I shall tell you of this in another lesson.

Thus you see the green leaves are the stomach of the plant. In them all the food is made of use.

LESSON VII.

SEEDS AND LEAVES.

TREASURE-BOXES.

THE seed is the egg of the plant. Just as the new chick is in the egg of the hen, or the new wasp is in the egg of the wasp, the new plant is in the seed.

Let us look at a hen's egg. It has a shell. Inside the shell is the clear white. Inside the white is the yellow ball, or yolk. The shell keeps the white and yolk safe. The white and yolk of the egg make the food by which the chick lives and grows,

before it is hatched. In the yolk you may see a tiny spot, which is the germ out of which the young chick will grow.

The eggs of all birds and insects vary little from this plan. The flower-seed is also an egg made on this same pattern.

The skin you saw on the bean serves for the shell. There is an inner skin often, like the silken skin inside the egg-shell. The food stored up in the seed-leaves serves as the yolk and white of the egg. The tiny germ between answers to the spot in the yolk, which is the chick germ.

The seeds of flowers differ more than the eggs of birds and insects. For some seeds have no coats at all. Some have only one. But in this lesson we speak of seeds as they commonly are. We tell you of seeds as you are likely to see them. The rarer things you must learn in larger books.

Let us look at seeds a little. Think how they differ in size. A great cocoanut is a very huge seed. If you ask your mother to show you her garden-seeds, you will find some as small as the finest grains of dust.

Seeds vary in color. Did any one ever give you a little round, bright India bean? It was red as a drop of blood. It had a jet black mark on one side.

If you look in the grocer's window, you will see yellow peas and green ones. You will see beans, — black, white, brown, yellow, purple, and spotted. Some of the garden-seeds are purple. Some look like the filings of steel, or silver, or gold.

Seeds vary in shape. You know how acorns and chestnuts look; they are seeds. Cherry-pits — stones, you call them, they are so hard — are round. A melon-seed is flat. Some seeds are three-cornered. Some have lines and dots as if they were carved.

Some seeds have little hooks on them to hold them to the ground so that they may not blow away. Other seeds use these hooks to catch upon things, that will carry them from place to place.

Did you ever see a thistle or dandelion seed go sailing through the air? It looks like a little silver ship, or balloon. It has a fine little feather on it to keep it up. The reason why thistles and dandelions grow far and wide is, that their seeds are carried about on the breeze.

If you live in town, go and look at the seeds in the seed-man's window. If you live in the country, suppose you collect all the seeds you can.

Did you ever think in how many ways seeds are kept from harm? What is a melon, or a pumpkin, but a big seed box?

"Oh!" you say, "melons and pumpkins are good to eat!" So they are, the better luck for us, that is. But all the plant wants of these big things, is to hold the precious seed.

An apple is a nice fleshy case to hold the seeds in the core. The cherry and plum are softer seed bags, which hold hard pits.

Did you ever look at a blackberry? You saw it was made up of little balls or knobs. Each of these soft, sweet knobs holds a tiny seed. A strawberry is quite different. The strawberry is a sweet red cone. Look, it is sprinkled all over with little yellow dots! Each of these dots is a seed.

I will tell you a little about the "why" of all this, in some other lesson.

You see the seed is that without which the plant cannot make a new plant. Without seeds there would soon be no more plants.

The leaves are those parts without which the plant cannot live and grow. But I think I hear some sharp child say, "How about those plants that have no leaves?"

In the few plants that have no leaves, the stem may help to serve in their place. But most of the few plants that have no leaves fasten upon other plants, and grow upon them. They use the leaves of those other plants to do their work.

In these simple lessons, I tell you of only common things. I speak of the things that you can see each day. For the rare things you must go to larger books.

You know from your last lessons that leaves are the stomach of the plant. Leaves are also the plant's lungs.

Plants must breathe. They must breathe in and out, as you do. Also the plants must get rid of the water which they do not need after they have taken the food out of it. Much of this water passes out through the leaves.

You know when you are very warm, you feel a moisture come on your skin. That was once water in your blood. It creeps out through tiny pores over all your skin.

The plant skin has such pores. The water goes off through them. When the plant breathes out this water, then more hurries up through the cells to take its place. So the sap keeps running up and down all the time.

Plants not only send out water through the pores of the leaves, but also a kind of air or gas. If they did not do that, we should soon all be dead. Can I make that plain to you?

Did you ever hear your mother say, "The air here is

bad or close"? Did you ever see your teacher open a door or a window, to "*air*" the school-room? If you ask why, you will be told "So many people breathing here make the air bad."

How does our breathing make the air bad? When our blood runs through our bodies it takes up little bits of matter that our bodies are done with. This stuff makes the blood dark and thick. But soon the blood comes around to our lungs.

Now as we breathe *out*, we send into the air the tiny atoms of this waste stuff. It is carbonic acid gas. As we breathe *in*, we take from the fresh air a gas called oxygen. That goes to our lungs, and lo! it makes the blood fresh and clean, and red once more.

So you can see, that when many people breathe in one room they will use up all the good clean air. At the same time they will load the air of the room with the gas they breathe out.

That is why the window is opened We wish to sweep away the bad air, and let in good air.

But at this rate, as all men and other animals breathe out carbonic acid gas, why does not all the air in the world get bad? Why, when they all use oxygen, do they not use up all the oxygen that is in the world?

Just here the plants come in to help. Carbonic acid gas is bad for men, it is food to plants. Oxygen is needed by animals, but plants want to get rid of it. Animals breathe out a form of carbon and breathe in oxygen. Plants do just the other thing. They breathe out oxygen and take in carbonic acid gas.

The air, loaded with this, comes to the plant. At once all the little leaf-mouths are wide open to snatch out of the air the carbonic acid gas. And, as the plants are very honest little things, they give where they take away. They take carbon from the air, and breathe into the air a little oxygen.

Where did they get that? The air they breathe has both carbon and oxygen in it. So they keep what they want,—that is, carbon,—and send out the oxygen.

Now it is only the green part of the plant that does this fine work for us. It is the green parts, chiefly the leaves, that send out good oxygen for us to breathe. It is the green leaf that snatches from the air those gases which would hurt us.

It is the green leaf that changes the harmful form of carbon into good plant stuff, which is fit for our food. How does it do that? Let us see.

What makes a leaf green? Bobby who crushed a leaf to see, told me "a leaf was full of green paint."

Inside the green leaves is a kind of green paste, or jelly. Now it is this "leaf-green" that does all the work. The "leaf-green" eats up carbon. The "leaf-green" turns carbon into nice safe plant material. It is "leaf-green" that sets free good oxygen for us.

"Leaf-green" is a good fairy, living in every little cell in the leaf. Leaf-green is a fairy which works only in the day-time. Leaf-green likes the sun. Leaf-green will not work in the dark, but goes to bed and goes to sleep!

In such simple lessons as these, I can tell you only a little of what *is*. The deep "how" and "why" of things I cannot explain. Even the very wisest men do not know all the how and the why of the "leaf-green" fairy.

I have told you these few things that you may have wonders to think of when you see green leaves. After this lesson, will you not care more for seeds and leaves than you ever did before?

LESSON VIII.

THE COLOR OF PLANTS.

ALMOST the first thing that you will notice about a plant is its color. The little child, before it can speak, will hold out its hands for a bright red rose, or a golden lily. I think the color is one of the most wonderful things about a plant.

Come into the field. Here you see a yellow buttercup, growing near a white daisy. Beside them is a red rose. Close by, blooms a great purple flower. All grow out of the same earth, and breathe the same air. Yet how they differ in color.

Some flowers have two or three colors upon each petal. Have you not seen the tulip with its striped blossoms, and the petunias spotted with white and red?

The flower of the cotton plant changes in color. Within a few days this flower appears in three distinct hues. The chicory blossom changes from blue to nearly white as the day grows warm.

Look at your mother's roses. Some are white, others are red, pink, or yellow. None are ever blue.

Then look at a wild-rose tree. The root and stem are

brown. The green color is in the leaves, and in some of the stems. The petals are red. The stamens and pistils are yellow.

You never saw the red color get astray and run into the leaves. The leaf-green did not lose itself, and travel up to the petals. The stamens and pistils did not turn brown instead of golden.

Does not that seem a wonder, now that you think of it? Perhaps you never noticed it before. It is one thing to see things, and another to notice them so that you think about them.

Here is another fact about color in plants. All summer you see that the leaves are green. In the autumn they begin to change. You wake up some fine frosty morning and the tree leaves are all turned red, yellow, brown, or purple. It is a fine sight.

It is the going away of the leaf-green from the leaf that begins the change of leaf-color in the fall. The leaves have done growing. Their stems are hard and woody. They do not breathe as freely as they did. The sap does not run through them as it did early in the season.

The leaf-green shrinks up in the cells. Or, it goes off to some other part of the plant. Sometimes part of it is destroyed. Then the leaves begin to change.

Sometimes a red sap runs into the leaf cells. Or, an oily matter goes there, in place of the "leaf-green."

The leaf-green changes color if it gets too much oxygen. In the autumn the plant does not throw out so much oxygen. What it keeps turns the leaf-green from green to red, yellow, or brown.

The bright color in plants is not in the flower alone. You have seen that roots and seeds have quite as bright colors as blossoms. What flowers are brighter than many fruits are?

The cherry is crimson, or pink, or nearly black. What a fine yellow, red, purple, we find in plums! Is there any yellow brighter than that of the Indian corn? Is there a red gayer than you find on the apples you like so well? What is more golden than a heap of oranges?

If you wish to find splendid color in a part of a plant, look at a water-melon. The skin is green marked with pale green, or white. Next, inside, is a rind of pale greenish white. Then comes a soft, juicy, crimson mass. In that are jet black seeds.

Oh, where does all this color come from? Why is it always just in the right place? The melon rind does not take the black tint that belongs to the seeds. The skin does not put on the crimson of

the pulp. See, too, how this color comes slowly, as the melon ripens. At first the skin is of the same dark green as the leaves, and inside all is of a greenish white.

Let us try to find out where all this color comes from. Do you know we ourselves can make changes in the color of flowers? Take one of those big hydrangeas. It has a pink flower. But give it very rich black earth to grow in. Mix some alum and iron with the earth. Water it with strong bluing water. Lay soot and coal-dust upon the earth it grows in. Very soon your hydrangea will have blue flowers, instead of pink ones.

Once I had a petunia with large flowers of a dirty white color. I fed it with soot and coal-dust. I watered it with strong bluing water. After a few weeks my petunia had red or crimson flowers. Some of the flowers were of a very deep red. Others were spotted with red and white.

Now from this you may guess that the plant obtains much of its color from what it feeds on in the soil.

But you may give the plant very good soil, and yet if you make it grow in the dark, it will have almost no color. If it lives at all, even the green leaves will be pale and sickly.

This will show you that the light must act in some way on what the plant eats, to make the fine color.

The plant, you know, eats minerals from the earth. In its food it gets little grains of coloring stuff.

But how the color goes to the right place we cannot tell. We cannot tell why it is, that from the same earth, in the same light, there will be flowers of many colors. We cannot tell why flowers on the same plant, or parts of the same flower, will have different colors. That is one of the secrets and wonders that no one has found out.

There are many plants which store up coloring matter, just as plants store up starch, or sugar. The indigo, which makes our best blue dye, comes from a plant. Ask your mother to show you some indigo. When the plant is soaked in water the coloring stuff sinks to the bottom of the water, like a blue dust.

Did you ever notice the fine red sumac? That gives a deep yellow dye. The saffron plant is full of a bright orange color. Other plants give other dyes.

Sometimes children take the bright petals of plants, or stems, that have bright color in them, to paint with. Did you ever do that? You can first draw a picture, and then color it, by rubbing on it the colored parts of plants.

Some trees and plants, from which dyes are made, have the coloring stuff in the bark or wood. That is the way with the logwood tree. The best black dye is made from that.

You have seen how much dark red juice you can find in berries. Did you ever squeeze out the red juice of poke or elder berries? It is like red ink. Did you ever notice how strawberries stain your fingers red? Grapes and blackberries make your lips and tongue purple.

No doubt you have often had your hands stained brown, for days, from the husks of walnuts. All these facts will show you what a deal of color is taken up from the soil by plants, changed by the sun, and stored up in their different parts.

But the chief of all color in the plant is the leaf-green. We cannot make a dye out of that.

Leaf-green is the color of which there is the most. It is the color which suits the eye best of all. How tired we should be of crimson or orange grass!

Though leaves and stems are generally green, there are some plants which have stems of a bright red or yellow color. Yellow is the common color for stamens and pistils. In some plants, as the tulip, the peach, and others, the stamens are of a deep red-brown, or crimson, or pink, or even black color.

LESSON IX.

THE MOTION OF PLANTS.

If I ask you what motion plants have, I think you will tell me that they have a motion upward. You will say that they "grow up." You will not say that they move in the wind. You know that that is not the kind of motion which I mean.

Some plants grow more by day, some by night. On the whole, there is more growing done by day than by night. At night it is darker, cooler, and there is more moisture in the air. The day has more heat, light, and dryness. For these causes growth varies by day and by night.

Warmth and moisture are the two great aids to the growth of plants. Heat, light, and wet have most to do with the motion of plants. For the motion of plants comes chiefly from growth.

The parts of the plant the motion of which we shall notice, are, the stems, leaves, tendrils, and petals. Perhaps you have seen the motion of a plant stem toward the sunshine.

Did you ever notice in house plants, that the leaves and branches turn to the place from which light comes to them? Did you ever hear your mother say that she must turn the window plants around, so that they would not grow "one-sided"?

Did you ever take a pot plant that had grown all toward one side, and turn it around, and then notice it? In two or three weeks you would find the leaves, stems, branches, bent quite the other way. First they lifted up straight. Then they slowly bent around to the light.

Perhaps you have noticed that many flower stems stoop to the east in the morning. Then they move slowly around. At evening you find them bending toward the west.

This is one motion of stems. Another motion is that of long, weak stems, such as those of the grapevine or morning-glory. They will climb about a tree or stick.

Such vines do much of their climbing by curling around the thing which supports them. If you go into the garden, and look at a bean-vine, you will see what fine twists and curves it makes about the beanpole.

Such twists or curves can be seen yet more plainly in a tendril. A tendril is a little string-like part of the plant, which serves it for hands.

Sometimes tendrils grow out of the tips of the leaves.

Sometimes they grow from the stem. Sometimes they grow from the end of a leaf-stem in place of a final leaf.

Tendrils, as I told you before, are twigs, leaves, buds, or other parts of a plant, changed into little, long clasping hands.

Now and then the long slender stem of a leaf acts as a tendril. It twists once around the support which holds up the vine. Thus it ties the stem of the vine to the support.

You have seen not only climbing plants, such as the grape-vine. You have seen also creeping plants, as the strawberry and ground-ivy. You will tell me that a climbing plant is one which travels *up* something. You will say, also, that a creeping plant is a vine which runs along the ground.

The climbing plant helps itself along by tendrils. The creeping plant has little new roots to hold it firm.

Look at the strawberry beds. Do you see some long sprays which seem to tie plant to plant? Your father will tell you that they are "runners."

The plant throws out one of these runners. Then at the end of the runner a little root starts out, and fastens it to the ground. A runner is very like a tendril. There are never any leaves upon it.

But the end of a tendril never puts out a bud. The end of the runner, where it roots, puts out a bud.

This bud grows into a new plant. The new plant sends out its runners. These root again, and so on. Thus, you see, a few strawberry plants will soon cover a large space of ground.

There is a very pretty little fern, called the "walking fern," which has an odd way of creeping about. When the slender fronds[1] reach their full length, some of the tallest ones bend over to the earth. The tip of the frond touches the ground. From that tip come little root-like fibres, and fix themselves in the earth. A new plant springs up from them.

When the new plant is grown, a frond of that bends over and takes root again. So it goes on. Soon there is a large, soft, thick mat of walking fern upon the ground.

This putting out new roots to go on by is also the fashion of some climbing plants. Did you ever notice how the ivy will root all along a wall? Little strong roots put out at the joints of the stem, and hold the plant fast.

All this motion in plants is due to growth. In very hot lands where there is not only much heat, but

[1] What you call the leaf of a fern is, properly speaking, a frond.

where long, wet seasons fill the earth with water, the growth of plants is very rapid.

In these hot lands, there are more climbing plants than in cool lands. Some trees, which, in cool lands where they grow slowly, never climb, turn to climbers in hot lands.

Some plants will twine and climb in hot weather, and stand up straight alone in cool weather. This shows that in hot weather they grow so fast that they cannot hold themselves up. When it is cool, they grow slowly, and make more strong fibre. But we must leave the stem motions of plants and speak of the motion of other parts.

Let me tell you how to try the leaf motion of plants. Take a house plant to try, as that is where wind will not move the leaf. Get a piece of glass about four or five inches square. Smoke it very black.

Lay it under the leaf, so that the point of the leaf bent down will be half an inch from the glass.

Then take a bristle from a brush and put it in the tip of the leaf. Run the bristle in the leaf so that the end will come beyond the leaf, and just touch the glass. Leave it a night and a day. Then you will find the story of the leaf's travels written on the glass. As the leaf moves, the bristle will write little lines in the black on the glass. Try it.

As you have proved the motion of the leaf with your smoked glass, let us look at leaf motion. There is, first, that motion which unfolds or unrolls the leaf from the bud. That is made because, by feeding, the plant is growing larger, and the leaf needs more room.

The leaf often has, after it is grown, a motion of opening and shutting. Other leaves have a motion of rising and falling. But of these motions I will tell you in another lesson.

Flowers have, first, the motion by which the flower-bud unfolds to the full, open blossom. That, as the leaf-bud motion, comes from growing. Did you ever watch a rose-bud, or a lily-bud, unfold?

Then the flowers of many plants have a motion of opening and shutting each day. I shall tell you of that, also, in another lesson.

Besides these motions in plants, there are others. Did you ever see how a plant will turn, or bend, to grow away from a stone, or something, that is in its way?

If you watch with care the root of one of your bean-seeds, you will see that it grows in little curves, now this way, now that. It grows so, even when it grows in water, or in air, where nothing touches it.

People who study these changes tell us that the whole

plant, as it grows, has a turning motion. In this motion all the plant, and all its parts, move around as they grow.

The curious reasons for this motion of plants, you must learn when you are older. I can now tell you only a little about it. I will tell you that the plant moves, because the little cells in it grow in a one-sided way.

Thus the air, light, heat, moisture, cause the cells on one side of the plant to grow larger than the others. Then the plant stoops, or is pulled over, that way. It is bent over by the weight. Then that side is hidden, and the other side has more light, heat, and wet. And as the cells grow, it stoops that way.

This is easy to understand in climbing plants. Their long, slim stems are weak. They bend with their own weight. They bend to the side that is slightly heavier. Their motion then serves to find them a support. As they sweep around, they touch something which will hold them up. Then they cling to it.

Now, there is another reason for a tendril taking hold of anything. The skin of the tendril is very soft and fine. As it lies against a string, or stick, or branch, the touch of this object on its fine skin makes the tendril bend, or curl.

It keeps on bending or curling, until it gets quite around the object which it touches. Then it still goes on bending, and so it gets around a second time, and a third, and so on. Thus the tendril makes curl after curl, as closely and evenly as you could wind a string on a stick.

Some plants, as the hop, move around with the sun; other plants move in just the other direction. It is as if some turned their faces, and some their backs, to the sun.

LESSON X.

PLANTS AND THEIR PARTNERS.

Did I not tell you that the plants had taken partners and gone into business? I said that their business was seed-growing, but that the result of the business was to feed and clothe the world.

In our first lessons we showed you that we get all our food, clothes, light, and fuel, first or last, from plants. "Stop! stop!" you say. "Some of us burn coal. Coal is a mineral." Yes, coal is a mineral now, but it began by being a vegetable. All the coal-beds were once forests of trees and ferns. Ask your teacher to tell you about that.

If all these things which we need come from plants, we may be very glad that the plants have gone into business to make more plants.

Who are these partners which we told you plants have? They are the birds and the insects. They might have a sign up, you see, "Plant, Insect & Co., General Providers for Men."

Do let us get at the truth of this matter at once!

Do you remember what

THE THREE PARTNERS.

you read about the stamens and pistils which stand in the middle of the flower? You know the stamens carry little boxes full of pollen. The bottom of the pistil is a little case, or box, full of seed germs.

You know also that the pollen must creep down through the pistils, and touch the seed germs before they can grow to be seeds. And you also know, that unless there are new seeds each year the world of plants would soon come to an end.

Now you see from all this that the stamens and pistils are the chief parts of the flower. The flower can give up its calyx, or cup, and its gay petals, its color, honey, and perfume. If it keeps its stamens and pistils, it will still be a true seed-bearing flower.

It is now plain that the aim of the flower must be to get that pollen-dust safely landed on the top of the pistil.

You look at a lily, and you say, "Oh! that is very easy. Just let those pollen boxes fly open, and their dust is sure to hit the pistil, all right."

But not so fast! Let me tell you that many plants do not carry the stamens and pistils all in one flower. The stamens, with the pollen boxes, may be in one flower, and the pistil, with its sticky cushion to catch pollen, may be in another flower.

More than that, these flowers, some with stamens, and some with pistils, may not even be all on one plant! Have you ever seen a poplar-tree? The poplar has its stamen-flowers on one tree, and its pistil-flowers on another. The palm-tree is in the same case.

Now this affair of stamen and pistil and seed making does not seem quite so easy, does it? And here is still another fact. Seeds are the best and strongest, and most likely to produce good plants, if the pollen comes to the pistil, from a flower not on the same plant.

This is true even of such plants as the lily, the tulip, and the columbine, where stamens and pistils grow in one flower.

Now you see quite plainly that in some way the pollen should be carried about. The flowers being rooted in one place cannot carry their pollen where it should go. Who shall do it for them?

Here is where the insect comes in. Let us look at him. Insects vary much in size. Think of the tiny ant and gnat. Then think of the great bumble bee, or butterfly. You see this difference in size fits them to visit little or big flowers.

You have seen the great bumble bee busy in a lily, or a trumpet flower. Perhaps, too, you have seen a

little ant, or gnat, come crawling out of the tiny throat of the thyme or sage blossom. And you have seen the wasp and bee, busy on the clover blossom or the honey-suckle.

Insects have wings to take them quickly wherever they choose to go. Even the ant, which has cast off its wings,[1] can crawl fast on its six nimble legs.

Then, too, many insects have a long pipe, or tongue, for eating. You have seen such a tongue on the bee.[2] In this book you will soon read about the butterfly, with its long tube which coils up like a watch spring.

With this long tube the insect can poke into all the slim cups, and horns, and folds, of the flowers of varied shapes.

Is it not easy to see that when the insect flies into a flower to feed, it may be covered with the pollen from the stamens? Did you ever watch a bee feeding in a wild rose? You could see his velvet coat all covered with the golden flower dust.

Why does the insect go to the flower? He does not know that he is needed to carry pollen about. He never thinks of seed making. He goes into

[1] See Nature Reader, No. 2, Lessons on Ants.

[2] No. 1, Lesson 18.

the flower to get food. He eats pollen sometimes, but mostly honey.

In business, you know, all the partners wish to make some profit for themselves. The insect partner of the flower has honey for his gains. The flower lays up a drop of honey for him.

In most flowers there is a little honey. Did you ever suck the sweet drop out of a clover, or a honey-suckle? This honey gathers in the flower about the time that the pollen is ripe in the boxes. Just at the time that the flower needs the visit of the insects, the honey is set ready for them.

Into the flower goes the insect for honey. As it moves about, eating, its legs, its body, even its wings, get dusty with pollen. When it has eaten the honey of one flower, off it goes to another. And it carries with it the pollen grains.

As it creeps into the next flower, the pollen rubs off the insect upon the pistil. The pistil is usually right in the insect's way to the honey. The top of the pistil is sticky, and it holds the pollen grains fast. So here and there goes the insect, taking the pollen from one flower to another.

But stop a minute. The pollen from a rose will not make the seed germs of a lily grow. The tulip can do nothing with pollen from a honeysuckle.

The pollen of a buttercup is not wanted by any flower but a buttercup. So of all. The pollen to do the germ any good must come from a flower of its own kind.

What is to be done in this case? How will the insect get the pollen to the right flower? Will it not waste the clover pollen on a daisy?

Now here comes in a very strange habit of the insect. Insects fly "from flower to flower," but they go from flowers of one kind to other flowers of the *same kind.* Watch a bee. It goes from clover to clover, not from clover to daisy.

Notice a butterfly. It flits here and there. But you will see it settle on a pink, and then on another pink, and on another, and so on. If it begins with golden rod, it keeps on with golden rod.

God has fixed this habit in insects. They feed for a long time on the same kind of flowers. They do this, even if they have to fly far to seek them. If I have in my garden only one petunia, the butterfly which feeds in that will fly off over the fence to some other garden to find another petunia. He will not stop to get honey from my sweet peas.

Some plants have drops of honey all along up the stem to coax ants or other creeping insects up into the flower.

But other plants have a sticky juice along the stem, to keep crawling insects away. In certain plants the bases of the leaf-stems form little cups, for holding water. In this water, creeping insects fall and drown.

Why is this? It is because insects that would not properly carry the pollen to another flower, would waste it. So the plant has traps, or sticky bars, to keep out the kind of insects that would waste the pollen, or would eat up the honey without carrying off the pollen.

I have not had time to tell you of the many shapes of flowers. You must notice that for yourselves.

Some are like cups, some like saucers, or plates, or bottles, or bags, or vases. Some have long horns, some have slim tubes or throats. Some are all curled close about the stamens and pistils.

These different kinds of flowers need different kinds of insects to get their pollen. Some need bees with thick bodies. Some need butterflies with long, slim tubes. Some need wasps with long, slender bodies and legs. Some need little creeping ants, or tiny gnats.

Each kind of flower has what will coax the right kind of insects, and keep away the wrong ones. What has the plant besides honey to coax the insect for

a visit? The flower has its lovely color, not for us, but for insects. The sweet perfume is also for insects.

Flowers that need the visits of moths, or other insects that fly by night, are white or pale yellow. These colors show best at night. Flowers that need the visits of day-flying insects, are mostly red, blue, orange, purple, scarlet.

There are some plants, as the grass, which have no sweet perfume and no gay petals. I have told you of flowers which are only a small brown scale with a bunch of stamens and pistils held upon it. And they have no perfumes. These flowers want no insect partners. Their partner is the summer wind! The wind blows the pollen of one plant to another. That fashion suits these plants very well.

So, by means of insect or wind partners, the golden pollen is carried far and wide, and seeds ripen.

But what about the bird partners? Where do they come in?

If the ripe seed fell just at the foot of the parent plant, and grew there, you can see that plants would be too much crowded. They would spread very little. Seeds must be carried from place to place. Some light seeds, as those of the thistle, have a plume. The maple seeds have wings. By these the wind blows them along.

But most seeds are too heavy to be wind driven. They must be carried. For this work the plant takes its partner, the bird.

To please the eye of the bird, and attract it to the seed, the plant has gay-colored seeds. Also it has often gay-colored seed cases. The rose haws, you know, are vivid red. The juniper has a bright blue berry. The smilax has a black berry. The berries of the mistletoe are white, of the mulberry purple.

These colors catch the eye of the bird. Down he flies to swallow the seed, case, and all. Also many seed cases, or covers, are nice food to eat. They are nice for us. We like them. But first of all they were spread out for the bird's table.

Birds like cherries, plums, and strawberries. Did you ever watch a bird picking blackberries? The thorns do not bother him. He swallows the berries fast, — pulp and seed.

You have been told of the hard case which covers the soft or germ part of the seed, and its seed-leaf food. This case does not melt up in the bird's crop or gizzard, as the soft food does. So when it falls to the ground the germ is safe, and can sprout and grow.

Birds carry seeds in this way from land to land, as

well as from field to field. They fly over the sea and carry seeds to lonely islands, which, but for the birds, might be barren.

So by means of its insect partners, the plant's seed germs grow, and perfect seeds. By means of the bird partners, the seeds are carried from place to place. Thus many plants grow, and men are clothed, and warmed, and fed.

LESSON XI.

AIR, WATER, AND SAND PLANTS.

Most of the plants which you see about you grow in earth or soil. You have heard your father say that the grass in some fields was scanty because the soil was poor. You have been told that wheat and corn would not grow in some other field, because the soil was not rich enough.

You understand that. The plant needs good soil, made up of many kinds of matter. These minerals are the plant's food. Perhaps you have helped your mother bring rich earth from the forest, to put about her plants.

But beside these plants growing in good earth in the usual way, there are plants which choose quite

different places in which to grow. There are air-plants, water-plants, sand-plants. Have you seen all these kinds of plants?

You have, no doubt, seen plants growing in very marshy, wet places, as the rush, the iris, and the St. John's-wort. Then, too, you have seen plants growing right in the water, as the water-lilies, yellow and white; the little green duck-weed; and the water crow-foot.

If you have been to the sea-shore, you have seen green, rich-looking plants, growing in a bank of dry sand. In the West and South, you may find fine plants growing in what seem to be drifts, or plains of clear sand.

Air-plants are less common. Let us look at them first. There are some plants which grow upon other plants and yet draw no food from the plant on which they grow. Such plants put forth roots, leaves, stems, blossoms, but all their food is drawn from the air.

I hope you may go and see some hot-house where orchids are kept. You will see there splendid plants growing on a dead branch, or some other dry thing, high up in the air.

Did you ever see a piece of mistletoe? It grows on some tree. It has nice green leaves and white

berries. That the mistletoe draws all its food from the air has been proved. It thrives as well on a dead tree as on a live one. A Frenchman, who loved to study plants, made a mistletoe plant grow on a cannon ball. Another mistletoe sprouted and grew from a seed held out on the point of a copper needle.

Thus, you see, these air-plants gain all their food from the air.

Water-plants will seem to you to grow in a more natural way. Most of them are rooted in the earth at the bottom of the pond, or ditch, where they grow. As the blossoms form, the flower stem grows long, and the flower rises to the top of the water.

There the lovely blossom floats about in the sunshine. It is moored by its long stem to the root, as a boat is moored by a rope. When the seeds are ripe, the flower stem sinks down again. The leaf stems rise to the top of the water. There the leaves lie spread out, to breathe the air.

Now when these leaves of water-plants are made to grow to the top of the water and live, they are broad, and often shaped like a shield. They are to spread out on the surface of the water, and catch all the air and sunshine that they can.

But there are other kinds of water-plants which have their leaves growing down under the water. All these leaves made to stay in the water are fringe-like and narrow. They look like wide leaves cut into many small strips.

Most sea-weeds have fringe-like leaves. Yet there are sea-weeds with wide leaves. They, like the fish, are made to live in the water all the time.

The fresh-water plants generally mean to come to the top of the water some time. They have green leaves. Their leaves can keep green only by the action on them of the air and light. This is why the leaf is made fringe-like. Its fringed leaves act as a net, floating around in the water. These leaf-nets catch not fish, but air-bubbles, and rays of light.

The water crow-foot, or water buttercup, has two kinds of leaves. Those at the bottom of the stalk are all in fine fringes. The leaves at the top are broad, like other crow-foot leaves.

There are some water-plants which do not root at the bottom of the pond. They spend all their lives floating about. A little plant called "duck-weed" is one of them. It has a soft, green body like two halves of a tiny pea. Its roots are three or four fine threads. It gathers all its food from the water.

Most water-plants have two sets of roots. One set holds the plant fast in its place. The other roots spring from the base of the leaves. They gather food from the water.

Now, while leaves that grow in the water are fringe-like, I think you will see that leaves of plants that grow in sand must be just the opposite.

If you examine a plant growing in dry sand, you will find that it has thick, soft, juicy leaves. The leaves of sand-plants are seldom flat. They are shaped like fringes, or the palm of your hand, or like little rolls.

Why is that? Can you not guess? The roots of these sand-living plants can get very little water. Only when rain and heavy dew fall can they get moisture. If they are wise little plants, they will store moisture up.

These sand-plants store up food and moisture in their leaves. It may surprise you that plants, growing in such dry places, have leaves so full of juice. The leaves are their pantry. They are full of saved-up water.

You will notice another thing. Many of the sand-plants have their leaves covered with prickles, hooks, and thorns. The leaves are rough, like burrs. Why is that? Is it not so, that birds and beasts will not want to eat them?

If the leaves are nipped off by animals, these plants must die. Their sand home gives them no water for their roots. If the leaves are eaten, all the plant must perish.

As there is so little water in the sand to carry food to the plant through the roots, the leaves of these plants must do most of their eating. So in the sand-growing plants the leaves serve as mouth, stomach, and pantry.

By the sea-side you will find plenty of sand-growing plants. You can study them, and prove these points for yourselves.

Children who are not by the sea may, perhaps, have, near where they live, a curious sand-loving plant, the cactus. The cactus prefers a sandy soil. I have seen a large cactus, covered with yellow blooms, growing right in a drift of clear sand.

You will notice that what you call the leaves of the cactus are not real leaves, but thick, odd-shaped stems. These stems are green, and answer for leaves. They are of many queer shapes. They are covered with little clusters of prickles. As they serve for leaves, these odd stems of a sand-plant are fleshy and juicy. The plant stores its food and drink in them.

LESSON XII.

PLANTS THAT EAT ANIMALS.

QUEER DIET.

You have now heard of so many wonders about plants, that perhaps nothing new which you will hear of them will surprise you. You may not even say "Oh!" when I tell you that some plants eat bugs, — as ants, gnats, and flies, — and will not even refuse a nice bit of raw meat!

These plants are called the "flesh-eaters." The name is a long one, — carnivora. Here is a verse about them. As it has long, hard words in it, I wish to say I did not make it.

"What's this I hear
About the new carnivora?
Can little plants
Eat bugs and ants?
Why this is retrograding!
Surely the fare
Of flowers is air,
Or sunshine sweet.
They should not eat,
Or do aught so degrading."

These animal-eating plants are so made that they catch insects, and suck up, or draw out, the juice of their bodies. This juice the plant seems to feed upon. It has been seen to pass from the leaf which catches the insect into the stem and other parts of the plant.

In all these insect-eating plants, it is the leaf that does the killing and eating.

I will first tell you of a little water-plant of this queer class. It is called the bladder-plant. It is one of the water-plants which float free. On the fringe-like leaves are little bags or bladders. These are full of air, and help the plant to float. The

mouth of these little bags has a door opening inward. It is set round with hairs.

The little insect-larvæ which live in water, and other tiny animals that swim about, see these little floating bags, with the small, green doors. The creatures act as if they wanted to know what was inside such pretty places. Finally they go in. To go in is easy. But once in, they cannot get out. The little door will not open outwards.

After a day or two, the animal thus trapped is all eaten. Only the hard, horny parts, which serve for its bones, are left.

There is another small plant, called the sun-dew, which eats insects. Any of you who live near a cranberry bog can find sun-dew growing on the edges of the bog. It is a plant that lives in wet places.

The sun-dew has a number of leaves about the size and shape of pearl shirt-buttons. They grow on short stems close to the ground. The leaves are covered with red hairs. These hairs are called tentacles. As many as a hundred and fifty will grow on one little leaf.

From these long, red hairs come tiny drops of sticky stuff. These drops gleam like dew. From them, and the little red, hairy rays, the plant has its name.

The insect comes flying by. The "dew" looks like something good to eat. But as soon as the insect touches the leaf, the juice holds its legs fast. The insect begins to kick, but cannot get away.

The struggles of the insect seem to irritate the plant. For, when the hairs are touched, they pour out more juice. Not only this, but the touch of the insect on the hairs causes the leaf to bend upwards. It bends over, over, folding down, until it is all shut up upon the insect.

Here is the insect held in the folded leaf. The glue runs out over it faster than ever. When you think how the insect breathes through tubes wound over all its body,[1] you will see that it must soon smother, held in this sticky juice.

When the leaf is bent over the insect, the juice changes. When the leaf is so bent, the juice is acid, or sour. This acid juice melts up the body of the insect. As it melts, the mouths, or glands, of the leaf seem to suck it up.

The sun-dew will melt up and devour bits of meat laid on the leaf. Water-drops on the leaf will not make it bend. But when milk-drops are put on the leaf, it bends, and sucks them up.

The leaf will not close over a piece of stone, or glass.

[1] See Nature Reader, No. 2, p. 77.

But it will close over a bit of boiled egg, or a scrap of bone. It melts the bone so soft, that you can stick a needle into it.

Another animal-eating plant is the Venus's-flytrap. It grows only in North Carolina. The leaf-blade has sharp bristles about the upper part. Each half of the leaf hollows a little, so that when the two halves come together they form a small pouch.

The leaf has some fine hairs which an insect cannot but touch, when it moves on the leaf. When the hairs are touched, the leaf bends. The bristles on the edges lock together, so that the insect is held in a cage, even before the leaf closes.

When the leaf is fully closed, the insect is held in a bag prison. The glands then pour out juice to melt up the body of the insect. As it melts, its juices are drawn into the plant.

The Venus's-flytrap does not seem to depend alone on the chance lighting of the insect upon it. It has a sweet juice on the leaf to attract insects. But it does not need as much sticky fluid as the sun-dew, to hold the insect. The two halves of the leaf snap together like a trap. They give the insect no time to get away.

Another very odd plant which eats insects is the side-saddle plant. This is often called the pitcher-

plant. It looks far more like a pitcher than like a saddle. The leaves of this plant are like a beautiful pitcher painted red and green.

These plants are common in the South. They grow also in marshy places in the North. I remember how happy I was when my father brought me three of them, when I was a little girl.

There are two or three kinds of these pitcher-plants. One kind is green, spotted with red, and has some yellow lines. Another kind is green with purple marks. You must notice that the inner side of the lid is of the brightest color.

Why is this? Insects see the gay color and fly to the plant. The leaves of the pitcher-plant are large, and they are bent and the edges grow together nearly all the way up. This forms a close pitcher which will hold water.

The seam where the leaves are joined is usually of a light yellow color. It is covered with a honey-like juice, in small drops. The rim of the pitcher and the inside of the neck have also these honey drops.

The insects, attracted by the gay color, come to feed on the honey. They feed along the seam and rim, and so into the throat of the pitcher. They seem to get dizzy, or so full of honey, that they feel dull.

They get down into the pitcher, and — there they stay!

Why do they not come out? For three reasons. The inside of the pitcher has a band of hairs growing downward. The insects cannot creep up through these. The hairs turn them back, as a brush fence turns cattle.

Then, too, part of the inside of the pitcher is so smooth that insects fall back when they walk on it. Still, as they can walk on glass, I think their slipping back must be due more to being dizzy, than to the smooth surface.

And here is the third reason, the pitcher is half full of liquid, and this liquid seems to make the insect dizzy. This liquid looks like pure, clear water. It tastes like the root of the plant, — a biting taste.

It is not like the honey-dew which lies on the seam for a bait. In this liquid, inside, the insects are drowned.

You may find many dead insects in one pitcher. I told you a little about this, in the last book, in the lessons on flies.[1] The dead bodies of the insects melted up seem to help to feed the plant. But often a pitcher catches more insects than the plant can use.

[1] Nature Reader, No. 2, pp. 59–60.

There are many kinds of pitcher-plants in very warm lands. You may be able to see some of them in hot-houses. All have the same general way of killing and eating insects.

LESSON XIII.

WEATHER PROPHET PLANTS.

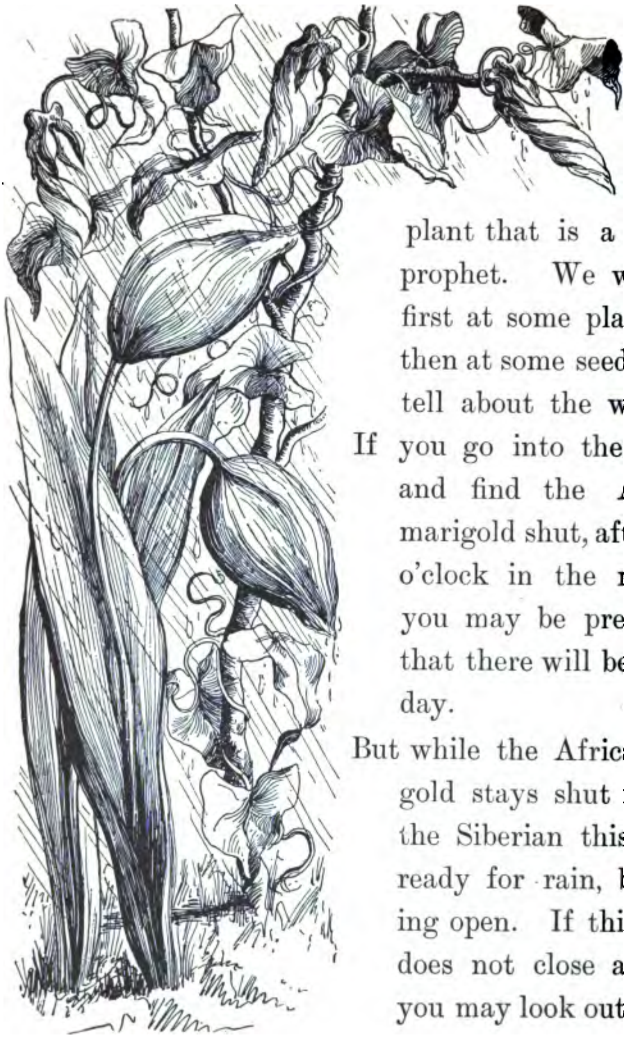
ONCE, when I was a little girl, I ran one morning to the garden, and said to the old Scotchman who worked there, "To-day I am going up the mountain for berries."

"No, no, Missey, not to-day," he said; "it will rain."

"No, it will not rain," I said. "The sun is up. The cook says it will be fair. The glass in the hall does not say rain."

"Tuts, tuts," said the old man. "I care for no suns, or cooks, or glasses. The pimpernel says it will rain, and so it *will* rain. Flowers, Missey, always tell the truth. When they say 'rain,' go, get your umbrella."

Sure enough, by noon, the rain was pouring down. After that, I looked with great respect at the tiny flower, sometimes brick red, sometimes blue, which could tell about the weather.



A RAINY DAY.

But the pimpernel is not the only plant that is a weather prophet. We will look first at some plants, and then at some seeds, which tell about the weather.

If you go into the garden, and find the African marigold shut, after seven o'clock in the morning, you may be pretty sure that there will be a rainy day.

But while the African marigold stays shut for rain, the Siberian thistle gets ready for rain, by keeping open. If this thistle does not close at night, you may look out for rain next day.

You see the marigold, which had origin in a hot land, stays folded, to keep the rain out of its petals. But the thistle, which had origin in a cold, stormy land, keeps wide open to get a good washing.

Did you ever see near the way-side the pretty little morning-glory or bind-weed, with its pink and white blossoms? Even if it is wide open, in the early day, it twists its striped cup close together, and droops its head, if a rain cloud drifts across the sky. It seems to want to shield its stamens and pistil from the wet.

There is a little single marigold, which shuts up in a hurry if the sky becomes clouded. It is called the "rainy-marigold."

Most plants which we call "weather prophets" shut up for rain. But some plants open for rain. The cause of the opening and closing is probably the difference in light. Most likely, these plants shut their flowers because there is too little light, not because there is too much moisture.

But you know there are some plants which shrink from a strong light, and love the shade. You will find that most shade-loving plants, as the verbenas, do not close for rain.

Lilies, tulips, and other flowers that love the sun, shut for rain. The tulip and crocus families are among

our best weather prophets. Just as the gay tulip shuts at evening, when the dew begins to fall, so it shuts for a shower.

Tulips are careful not to open their cups very wide in the morning, if it is likely to rain. The roses make no change; they seem not to fear wet.

On the whole, you may be pretty sure, if you go into your garden, and find many flowers, as tulips, marigolds, morning-glories, and celandine, shut, it will be a stormy day, unfit for picnics or long walks.

Just as some blossoms are weather prophets, so are some seeds. But in the case of the seeds it is the moisture, not the light, which affects them.

Among these seeds, that of the wild-oat is chief. When the air is moist, the long bristles, called awns, on the seed, squirm and twist. In old times, before people knew why this was, they said that this seed was a witch!

There is a marigold which grows at the Cape of Good Hope, and in dry weather has its head of seeds held close, like a round button. When rain is coming, this seed-head opens out, like a star with many points.

Do you see the use of these motions? The wild-oat, as it wriggles and twists back and forth, from the

dampness of the air, or earth, twists its way into the soil. It plants itself by these motions.

The marigold keeps its seeds safe in dry weather, which would kill them. When rain comes, it opens the seed-head. Then the seeds fall out on moist earth, where they will sprout and grow.

Some seed-pods fly open when they are dry. The sand-box tree has seed-pods as large as an orange. They fly open in dry weather.

What is the reason of all these queer actions of the flowers? No doubt they are all due to light and moisture. To light, most of all.

The little pimpernel probably needs much heat and light to open its petals. Even a little moisture in the air, or a little less light than it likes, will cause it to keep shut.

A pimpernel in full bloom will close its blossoms almost as soon as you pick it. Very likely the slight moisture of your hand causes it to do that.

This motion of closing, during rain, may be very useful to some flowers. A frail flower with a large cup, such as a tulip or crocus, might, if open, be broken to pieces by a heavy shower. These flowers fold up, and expose only a close-pointed bud, to the storm. Then no rain can get among the petals.

Also, the rain might break the large pollen cases of the

tulip, and wash the pollen all away. So, if the convovulus had its long tube filled with water, the stamens and pistil would perhaps be harmed, and its seeds would not be able to grow.

LESSON XIV.

PLANT CLOCKS.

I KNEW an old man who made a great clock for his grandchildren. What kind of a clock do you suppose it was? The clock was in the garden, and it was made of flowers.

Did it tell the time well? Only pretty well. Flower clocks are as liable to get out of order as clocks made at a factory.

This clock was a great flower bed, divided into twelve parts. The divisions were marked out by little rows of box-plants. In the middle was a post three feet high. It had two clock hands on it, but *they* were only for show. They did not move.

But the post had a sun-dial on it, and that gave true time. So the children could tell when the flower clock was not working well.

As there are twelve hours of day and twelve of night,

and some plants open only at night, each of the twelve divisions of the clock was divided into two parts by a little line of red colors. On one side of this were the night bloomers, on the other side the day bloomers.

The children thought it lovely, and were proud of it. And the clock did for them what the grandfather wished, — it made them like and notice plants.

I have just said that there are plants which open only by night, and others which open only by day. This opening and shutting for day and night is called "the sleep of plants."

This sleep of plants is not because the plant is tired; it is due to the absence or presence of light, and to changes in the amount of light. Yet, no doubt, in it the organs of the plant do rest, as their growth and action are not then so rapid.

Both the flowers and the leaves of plants have this sleep motion. We will look first at the sleep of flowers.

You have noticed that the morning-glories are open when you rise, and that they fold or shut up by noon. Have you in your garden a flower with gay yellow or scarlet blossoms, called the four-o'clock? That does not open until about four in the afternoon.

As you run to school in the morning, the dandelions are gay along the way-side. When you come from school in the afternoon, the dandelions are all folded in their green cups.

If this is so, why does not the flower-clock tell true time? You can see that owing to the changes in the heat and rising of the sun in different places, and seasons, the sleep of the flowers would not begin at the same time.

I have seen my morning-glories open as late as nine o'clock, and stay open all day in cool October days. In August they opened by six and were shut by eleven. So the four-o'clocks and dandelions may vary by an hour or two.

All the water-lilies shut at night. Some not only shut, but draw their heads down under water. I will tell you when you will find some flowers opening. At four in the morning you will find the goat's-beard and the blue chicory opening. The chicory petals are then a fine blue. They become lighter in color until near mid-day, when they are almost white. Chicory is called "Miss-go-to-bed-at-noon" by some children, as the flowers shut at noon.

At five in the morning the common morning-glory and the poppy open. At six the yellow hawk's-weed

and dandelions look out on the way-side. At seven the water-lilies smile at us. At eight, if the day is fine, the pimpernel opens its red eyes.

At nine the marigold spreads out, and the tulip. At noon, on a hot day, you will find the tulip opened nearly flat. At eleven the star of Bethlehem shuts up, while most of the day flowers are in their best bloom.

At twelve the lazy passion-flowers awake, and the sweet-peas have their banners opened wide. At two the wild daisies are brightest. Then at four in the afternoon, out comes the four-o'clocks, and at five the "beauty of the night," and at six the delicate evening primrose. At seven the white lychnis, which blooms only at night, opens. Later still the night primrose puts out its white bloom, and at two o'clock in the morning the purple convolvulus wakes up and wonders why the sun is so late.

Now, in sleeping, most of the flowers close tight together. Besides the rest to the growing organs, which sleep brings them, this folding up keeps moisture from the pollen. Also, the flowers, whose partners are day-flying insects, keep out of the way of night insects by closing their pretty doors.

The evening primroses, night lychnis, and others, which have night-flying insect partners, keep shut when

day insects are about. You will notice that most of these night plants have yellow or white petals, and a sweet perfume.

I have told you the leaves sleep also. Leaves sometimes sleep by closing the two halves of the leaf together by the mid-vein. Other leaves sleep by dropping the leaves down against the stem.

A young Swiss girl was one of the first to observe this sleep motion of leaves. She saw it first in the clover. When the leaves sleep in this way, you might think them faded and dying.

You will do well to watch this sleep of leaves. If you go into a garden, or field, or on the road-side, you will see that the leaves look very different after sunset from what they did in the noon-day.

The yellow sorrel and the clover are plants in which you can watch leaf-sleep well. You will find the small leaflets hanging down against the stalk. So if you look at the beans in the garden, you will see their leaves falling back, and perhaps a little bent over. One kind of oxalis, with very small, compound leaves, lifts its leaf up all in a bunch to go to sleep.

The leaves of trees have sleep-change. The mimosa and the barberry close their leaves at night.

Are these sleep motions of any use to plants? Yes.

It has been found that this folding up, and falling back of leaves, will help them to resist cold and wet.

If, during a cold night, you pin the leaves out, so they cannot take the sleep position, they are likely to freeze. Also this change in the leaves, at night, helps to shield the plant from too much dew.

Sometimes, also, it is of use as it turns toward the dew the under side of the leaf. This under side has the most mouths for drinking water. Thus the flower has a good drink at night, after the dry, hot day.

Among the other motions of plants, I might speak of that of some leaves, which curl or shrink if you touch them. But I have not space for that now.

Perhaps you think that these lessons have told you a great many things about flowers. If you go on with the study of plants, you will see how much there is to tell, and how very little has here been told.

These lessons are only meant to stir up your interest in plants, and show you what wonders are in the plant world. After that, you will be sure to learn more for yourselves.

LESSON XV.

THE SCHOOL CABINET.

One of the wise teachers who are all the time thinking what will help and interest children wrote me a letter. In it, he said, "If you wish to do our school children a real service, write something about cabinets in our schools. In each school-house there should be a collection of natural history objects, brought together by teachers and children. This would be of great use, and the children would take pleasure in collecting specimens."

So, right here, in the middle of this Third Book, I want to say a word about cabinets of natural curiosities.

In the Second Book I told you here and there how you might catch and keep a specimen. I told you how to dry beetles, star-fish, and a few other little animals.

If you make a collection of this kind, you can look at the object when you read of it in the book. That will help you to understand it and will interest you.

In a cabinet you could keep safely for use many nice things, which might otherwise be wasted. Also, you might spend some of your pennies in buying specimens. I think pennies are much better spent so than for candy and cake.

If you are collecting a cabinet of curiosities, I think you might write letters to other schools, or far off friends to ask them to send you specimens.

You might offer to trade objects, of which you have several, for something which other people have, and you have not.

I think, too, you would be very happy out of doors, looking for specimens. And I believe you and your teachers would be greater friends than ever, if you were all helping each other to get a cabinet together.

If, at first, you cannot have a cabinet case with glass doors, have some shelves. Have some boxes to set on the shelves, and lay pieces of glass over the boxes for covers. Those little paper boxes—, which jewellers and druggists use, are very nice for small objects,—as seeds, little shells, and so on. Nearly all children have some of these boxes.

When you have specimens in these little boxes, the teacher will write the name of the object on the box.

I knew a boy, who made a very nice collection of many kinds of wood. He cut the wood into wedges, with a bit of the bark left on. One side of the wedge he polished with glass and sand paper. One side he left rough. He wrote on each piece of wood the name of the tree from which it came.

I once saw some lovely pictures of leaves. They were made by a little girl. How did she make them? Could she paint? No.

She had some small sheets of stiff paper. She got some printer's ink in a cup. She made two little balls of woollen cloth. She would take a nice, fresh, perfect leaf, and with one ball she would put a little ink, very gently, over all the under surface of the leaf. Then the next thing was to lay the leaf, inked side down, on a sheet of stiff paper, and pat it gently all over with the other woollen ball.

When she lifted up the leaf she had a picture of its shape, and of all its veins and edges. It looked like a nice engraving. She put the same kinds of leaves on the same sheet,—as the leaves of the rose family on one, the leaves of maples on another, and so on. Under each leaf she wrote its name.

Such a collection of leaf-patterns is fine in a cabinet. So is a collection of dried flowers,—called an herb-

arium. Your mother or teacher could show you how to make one.

You will find on the way-side, or in field and garden, some of those wonderful nests, built by spiders, wasps and bees, of which you read in the First Book of Nature Readers. And at the sea-side, you can find crabs, shells, and bits of coral, sponge and sea-weed.

Did you ever think what a pretty sight a row of pieces of many kinds of stone makes? Have you thought that stones are just hard, homely, brown things?

Have you noticed that marble is sometimes snow white, sometimes black, or veined with many colors? The granite is gray; sandstone is red, or gray, or purplish. Slate is black, purple, or veined in many shades. Other stones are black, red, yellow, brown, green, in fact of nearly all hues.

Each kind of stone has its own name. Some come from one place only, some from another. There is a reason why each kind has its color and grain. As you grow older, you may like to study about rocks and stones. Then how nice it will be to have on hand a collection of specimens.

A collection of birds' nests is very fine. As we study in this book a little about birds, you will see how

many kinds of nests there are. If you have a cabinet you can put into it one nest of each kind that you can find. Put into each nest one egg of the kind that belongs to the nest. Then put into the nest a little card, with the name of the bird, and the number of eggs commonly laid in each nest.

Be sure you do not break up the nest of a sitting bird. That is cruel. To keep the eggs you must blow them. Make a hole with a large pin in each end of the egg. Then blow hard, steadily in the pin-hole in the large end. All the inside of the egg will fly out at the hole at the other end.

Our next lesson will be about grasshoppers and their cousins. As the bodies of grasshoppers shrink when they dry, it is well to stuff them. How can you do that?

Put a little cotton wool on the end of a short thread, threaded in a long, coarse needle. The grass-hopper should have been dead an hour or two, before you try to stuff it. Take it by the head and pass the needle through from the back end of the body, and bring it out under the breast. If you draw it gently, the cotton will go in with the thread.

Several pieces of cotton drawn in, in this way, will fill

the body enough to hold it in shape. If the cotton is wet in alcohol, or camphor, it is better.

Worms, spiders, toads, minnows, and such soft-bodied things, must be kept in clear glass bottles, filled with alcohol.

Now the chief thing in a collection is to have it good of its kind. The specimens should be as perfect as possible, and be kept neat and clean. Especially they should be set in good order. They should all have labels, with their names on them.

A collection well marked will be worth much more than one without the names placed on the specimens. A collection all jumbled together, without order, will be of little use.

If you set a bird's nest here, a wasp's nest there, a bright stone next, and then a beetle, or a card of butterflies, your cabinet will have small teaching value. Remember a cabinet is not merely made to "look pretty" like a doll's house, or a shop window.

Place things of a kind together. Then put kinds which are nearest like next each other. Put your insects together, and arrange them by their orders. Put the beetles together, the butterflies together, the wasps, and bees, and so on. Spiders come in as one order of the insects. Your crabs and

shrimps must stand together, but be placed next the insects, as they are of the jointed class of creatures.

Put your birds' nests, and eggs, and any stuffed birds, or pictures of birds that you may have, together. And so on, with all the other things.

Your cabinet may be a small one, but if it is neatly arranged, and all the specimens are good of their kind, rightly named, and kept clean, it will be of real value.

Do not be in such a hurry to collect, that you put in rubbish, instead of good specimens. A butterfly with broken wings, a beetle without a head, and a spider that has lost half its legs, are not worth a place in a cabinet.

To get together even a small cabinet of objects in natural history, takes time, care, and patience. I knew a girl who was carefully collecting and mounting beetles. In a whole summer she got only twenty-five. But each one was perfect, different from the rest, nicely fastened in place, and had its name written beside it. So her collection was of real value.

After you have secured a nice little cabinet, the trouble will be to keep it safe, and in order. Specimens must be taken care of. All specimens of plants,

and insects, are very liable to be destroyed by little bugs. Only the things kept in alcohol are really safe from being eaten.

Camphor and red pepper are of some use to keep out these enemies. Your teachers will know, or can easily learn, how to prepare the specimens with poisons, which will kill the mites and not harm you or the specimens. You must leave it to them.

It is nice to have a case with glass doors. If you cannot have that, arrange as many of the objects as you can in boxes with panes of glass laid over them. For open cabinets it is well to have a piece of fine gauze to lay over each shelf, or over the whole set of shelves, when the cabinet is not in immediate use.

Dust makes a cabinet look very ugly. But you cannot clean off beetles and butterflies with a dusting cloth or brush. It would ruin such delicate things.

You can gently move the boxes and specimens, and wipe off the shelves, and the sides of the boxes. Then blow, or fan, the dust from the specimens. Even minerals should have the dust blown from them, not wiped off. It is easy to rub the bloom and the little fine points, and edges, from a mineral specimen.

When you have made up your minds to have a cabinet

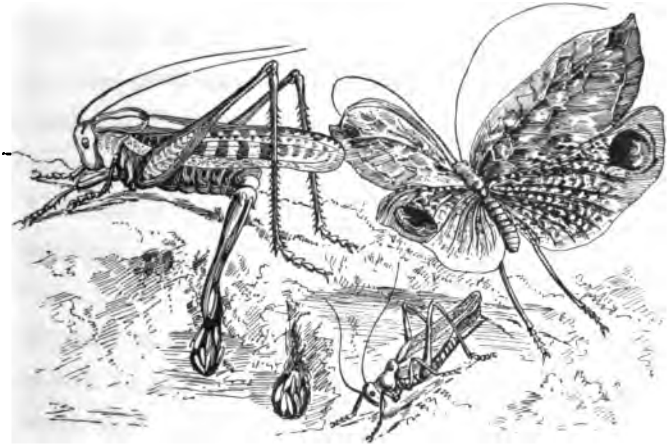
in your school, look about and see what your friends have to give you for it. Many people have a few natural history curiosities, for which they do not really care. Such persons would gladly give their treasures to a school cabinet. But there should be some bright little lad or lass to say: "Oh, we have a cabinet at our school. Would you not be willing to send these things there?"

Correct pictures of birds, fish, insects, and flowers, are useful in a cabinet, but you must be sure that they are correct before you give them a place. You must not put the pictures into your cabinet merely because they are pretty. If they are wrong they will give you false ideas. I have seen colored pictures of insects with some of the legs set upon the hinder part of the body instead of all upon the chest part. Such a picture is of no use.

Keen eyes to see what comes in your own way, and keen wits to suggest to other people what they can do for you, will steadily help to build up the school cabinet.

LESSON XVI.

THE OLD MAN OF THE MEADOW.



THE OLD MAN AND HIS FAMILY.

WHEN I was about seven years old, I caught a grasshopper and put him into a bottle.

Then I sat down outside the bottle, and looked at the grasshopper. He sat inside the bottle, and looked at me.

It began to grow upon my mind that the grasshopper looked much like an old man. His face, with the big, solemn eyes, and straight mouth, was like an old man's face.

He wore a gray coat, like a loose duster. He had a wrinkled greenish vest. He wore knee-breeches and long red stockings.

The more I looked at him, the more he looked like a little, grave, old-time man who came to visit my aged grandfather.

I had a cousin who at dusk would sit with me in a corner of the big sofa, and repeat to me a poem, called the "Prisoner of Chillon." That sad poem had made me feel very sorry for all prisoners. I thought my grasshopper in the bottle felt like a prisoner. I said, "Now you may go, my Old Man of the Meadow."

I took the cork out of the bottle. The grasshopper at once leaped up, and sat on the rim of the bottle. Then a strange thing happened! The Old Man of the Meadow spread out two wide brown wings. They had a broad, lemon-colored band on them. They were gay as the wings of a butterfly! On them he sailed away!

I could hardly believe my eyes. I ran after him to a tall stalk of golden-rod. There he sat a plain, gray-green old man. But again he spread out the wide wings, and was gone!

My Old Man of the Meadow had then this splendid dress-coat under his sober overcoat! Seated at

rest, he looked plain and quiet, — a creature of the earth. Lifted into the air, he was nearly as fine as a butterfly.

Do you not wish to know something more of this Old Man of the Meadow, the grasshopper. The name of this insect at once tells you something about him. He lives much in the grass, and his chief motion is in hops, or long jumps. He has another name, "the murmurer." This is given because of the noise or song he makes. He sings to Mrs. Grasshopper. His song is loud and shrill. It is made by rubbing his wings one upon the other.

He has a little piece of skin like a tight drum-head set in each wing. As he moves his wings, this tiny drum vibrates, or trembles, and makes the shrill sound.

Mrs. Grasshopper does not have this drum in her wings. She has, however, at the end of her body, a nice little sword. The French call her "the jumper with the sword." Is her sword to fight with? No. This little sword opens into several blades. She uses it to place her eggs snugly in the ground. The sword blades open, and the eggs slide safely down between them, into the little earth-bed. There they lie until the young grasshoppers hatch out.

You will find, as we study about grasshoppers, that they do not all live in the grass. Some spend most of their time in trees.

Let us take a closer look at the grasshopper. As he is an insect,[1] he should have a body made in rings, in three parts, with four wings and six legs set on the second, or chest part.

Just here let us say, that if you will look closely you will see that the head of an insect is made of four rings, and its chest is made of three rings. They are rings grown wider than the rest.

Our Old Man of the Meadow does not lack any of the parts which a proper insect should have.

The order which he belongs to is called the *straight-wings*, because the insects belonging to it do not fold their wings crosswise.

The grasshopper family is called the family of "the murmurers," from their music.

There are six families of the straight-wings. In this book we shall study a little about three of them, — the grasshoppers, the crickets, and the locusts. If you wish, also, to learn about their cousin, the cockroach, suppose you, who live in city houses, go down to the kitchen, and catch him about the water pipes, and study him for yourselves!

[1] See Nature Reader, No. 2, Lessons 1–4.

The order of straight-wings is often divided in this way: The runners, — as the cockroach; the snatchers, a kind which have their fore-feet something like hands, to snatch with; the walkers, who seldom fly or jump; and the jumpers. The grasshopper is one of the jumpers.

If you look well at the grasshopper, you will see that his front pair of legs is shorter than the others. This hinders him in walking over a level surface. But it helps him in walking up a tree, or small plant, or a wall.

See the hind legs! They are more than twice as long as the others. The thigh, or upper part, is very long and strong. By means of these big legs, the grasshopper is a famous jumper.

Now, if you have a grasshopper to look at, you will see that the feet have four parts. The part of the leg between the foot and the thigh has sharp points like the teeth of a comb.

The hind part of the body is long and slender, and, being made of rings, can bend easily. In the great, green grasshopper all the body is of a fine green tint.

Let us look at the wings. The upper pair, or wing-covers, are large and long. Notice two things about the wings; they lap at the tips, and are

high in the middle. When they are shut, they have a shape like a slanting roof. The upper ones are longer than the lower ones.

These wing-cases have large veins. Lift up a wing-case and pull out a lower wing. It is folded very closely, in lengthwise plaits. Where these wings join Mr. Grasshopper's body, you will find his drum-plate for making music. One kind of grasshopper has very short wing-covers. In that kind, both Mr. and Mrs. Grasshopper make music. There is also one grasshopper, a little, green fellow, that has no drum; he is silent.

The upper side of the grasshopper's chest is shaped like a large, horny collar. The head is large, and has two big, glossy eyes. There is, also, a knob on the forehead. Between the eyes, are set the feelers. They are very long; even longer than all the body.

The mouth of the grasshopper is wide, and it has strong jaws. But they are not so strong as those of his cousin, the cricket.

Grasshoppers prefer vegetable food. They will sometimes eat animal food. When shut up in a box, they will fight, and the one which gets killed will be eaten by the victor.

A grasshopper which lost its leg while being put into a box, ate its leg. Like the other winged creatures,

grasshoppers lose their legs easily, and do not seem to mind it.

If you could look inside the grasshopper's body, you would see that he has a gizzard, much like that of a chicken. It is made of little bands set with fine teeth. These teeth chew up into a pulp the leaves which the grasshopper has eaten.

LESSON XVII.

THE LIFE OF THE OLD MAN OF THE MEADOW.

Many years ago, a great poet wrote a song to the grasshopper. The poet said the grasshopper was the happiest of living things. It did nothing but dance and sing. It ate fresh leaves, and drank cool dew. When the glad summer of its life was done, it died. It did not live to be sick, or hungry, or cold.

This poet called the grasshopper "the earth-born," and said that it was man's little brother.

Yes, the grasshopper is earth-born. The mother grasshopper makes, with the sword of which I told you, a hole in the ground. In that she lays her eggs, in a case made of something like glue. Then she closes up the hole, and the eggs lie all winter, safe in the ground.

In the spring, the larvæ hatch from the egg, and creep out of the ground. They are very small, but shaped much like the parent, only they have no wings. They molt, or change their skins several times.

At first, the little ones are all alike, but after several changes of skin, the larvæ become pupæ. Then you can see the coming wings under a little sheath. You can also see Miss Grasshopper's sword growing.

About six or eight weeks, after hatching, the final change is made. The perfect insect comes out of its last-shed skin. It has now two pairs of wings. Mr. Grasshopper plays on his new drum, and Mrs. Grasshopper marches about with her new sword.

The young grasshoppers are very greedy while larvæ and pupæ. They eat all the time. When they are grown, they do not give all their time to eating. Mr. Grasshopper must sing, and he does not do this while either flying or eating.

He stands quite still, fixes himself firmly by his fore-feet, and presses his body downward. There is a little quiver through all his body as long as the sound lasts.

The people of Italy call him "the screamer," or "the squealer," from his shrill noise.

The grasshopper has a very odd habit. After he has

eaten for a long time, he sits quite still. He looks as if he were doing some serious thinking. Sometimes when he sits in this way, he moves his mouth as if chewing. From this action, people used to think that he chewed the cud, as cows and sheep do.

But he does not chew the cud. If you watch him well, in these silent times, you will see him gravely licking his long feelers, and his lips. He seems to be cleaning them.

To do this, he runs out a long, limber tongue, shaped much like yours. You remember that the ants have this habit of cleaning and dressing themselves, after eating.[1]

The great, green grasshopper, which lives on the trees, has wings of a gray-green. He has a little bronze, or russet color, on his feet, and on the under part of his body. The rest of his body is a fine leaf-green.

The color in the grasshopper does not seem to be laid on the surface of his coat, as on that of the beetle. It is not put on in plumes and scales, as the butterfly has it. But it is dyed through and through the wings and body.

The wing-cases of the grasshopper, and the rings of the

[1] See Nature Reader, No. 2. Lessons on Ants.

body, are not hard, and like horn or shell, as in the beetle tribe. They are of a tough skin, and are dyed with the color.

Let us have a look at some of these fine fellows. Although the color of the great, green grasshopper is so gay, it will be hard to find him. His coat is just the tint of the leaves he likes to live among. You can scarcely see him even if you look straight at him.

You will find in the grass a smaller, lighter-green hopper that is very easily caught, because in his hurry to get away he flies right up in your face, when he hears you coming.

The grasshoppers are a very timid family, and are very sensitive to sound. Some say that their long feelers serve them for ears. But that is not true.

The garden grasshopper has very small wings. Its color is brownish gray. It likes to live in the garden walls or under the leaves in the borders. Both Mr. and Mrs. Grasshopper sing in this garden family. They keep up fine music for those who like to hear them, as one answers the song of the other.

I think we most of us like the cry of the grasshopper. It brings to our mind the warm, dry, sunny days, the time of flowers.

Out in the meadow you will find our Old Man, the common great gray hopper. As the great, green one in the trees is hidden by his color, so is the great, gray one hidden in the grass. His coat is the hue of the half-dry grass, with little tinges of green along it.

He seems a very plain insect at first. But watch him and notice the light red and yellowish bands on his legs. He has spots of soot color on his wing cases. When he spreads his wide wings, note the brown and yellow stripes. He is fine enough after all.

In the woods, among the pine and fir trees, you will find a light-green, small, slim grasshopper a deal like the garden singer.

There is a very handsome, large grasshopper called the wart-biter. The boys in Sweden give him this name, because they think he can cure warts. They think that if he bites a wart, and puts some dark brown juice on it, the wart will go away.

The wart-biter is nearly two inches long. It is a green-gray with reddish legs and feet. It lays its eggs in little balls in the earth.

In South America there are very large and splendid grasshoppers. Their wings are so gay that when they fly they look much like butterflies. The wings, in flight, cover most of the body.

But when you see the large, long legs stretched out behind, and the very long feelers waving to the tips of the wings, you will know that this is a grasshopper. All this brown and black and crimson splendor is the Old Man of the Meadow, with a very fine coat.

The grasshopper is not migratory. It does not change its home. It dies near where it was born. Frost and cold kill it. It does not outlive the winter, as butterflies, bees, and wasps do.

Grasshoppers appear in great numbers, but they do not go in swarms as locusts do.

Each grasshopper lives alone. He does nothing for his neighbor, and his neighbor does nothing for him.

When grasshoppers are numerous they damage the grass and the young crops.

LESSON XVIII.

THE ROBBER COUSIN.

The Old Man of the Meadow is, in his way, like a quiet country gentleman. He roams about the fields, and likes to sing, and is fond of moonlight. He likes the shade, and the cool, still places under the green herbs.

He has a fierce cousin, who is a great robber, a kind of land pirate. His name is *locust.*

I asked a class of boys, "What is a locust?" One said: "It is a great, big grasshopper."

Another said: "It is a greedy grasshopper that eats everything."

A third said: "A locust is a grasshopper that travels in swarms."

Now these were pretty good answers. Each had some truth in it. A locust is *not* a grasshopper. But it is much like a grasshopper. It is his very near relative.

The locust is not always larger than the grasshopper. The great green, or the wart-biter grasshopper, is larger than the Rocky Mountain locust. That locust is called "the hateful," because he does so much harm.

The locust is generally larger than the grasshopper, and one very big locust is much larger than any grasshopper that ever was known. And, too, the locust is much more greedy.

The locust destroys all plants that come in its way. It will eat the bark off the trees.

Locusts live and move in swarms. Instead of living and dying in the places where they were born, they are given to travel. They migrate like the birds you will read of in this book.

It is not quite surely known what is the motive for their journeys. Probably it is to get food. The locust is the child of hot lands. His first home was, no doubt, in the great sandy plains of Asia. He is very common in Africa. In Europe and the eastern part of the United States he is not very common. In the Western States he has done much damage.

If you take up a locust to examine, you will at once notice that his feelers are much shorter than those of the grasshopper. Mrs. Locust also is without the sword for placing her eggs. She lays them in the earth in long tubes.

The front of the locust's head is harder and thicker than the grasshoppers. The hind legs are also much thicker and stronger than even the big strong ones of the grasshopper.

The locust's coat is of light brown or sand color. There is a delicate green tinge on the wings. The breast has a soft vest of down. The legs are often striped in bands of brown and yellow.

The locust does not make his music as the grasshopper does. When he wishes to sing, Mr. Locust stands on his two front pairs of legs. Then he lifts his hind legs, and draws them one by one, or both together, over his wings.

The inner side of the hind legs has rough file-like edges. The wings have thick veins, which stand like cords above the wing surface.

The file parts of the legs rub on these cords, and produce the sound. The sound takes different tones, as one or both legs are used at a time in making it. Sometimes the sound is very loud, sometimes it is very low.

In the latter part of the summer, Mrs. Locust lays her eggs, fifty or one hundred together, in a tube hidden in the earth. In places where locusts do much harm, rewards are given for baskets full of these tubes. Many boys make a living by digging them from the earth, and selling them to be destroyed.

For you must know that locusts being very greedy, and very numerous, do much harm. They move quickly, and in great swarms. Though they live in swarms they have no queen as the bees have, and they do no work as bees and ants do.

Probably there is no living thing seen in such numbers as the locusts. We can scarcely believe or understand what we are told about the multitudes of these insects which appear in the East.

They fill the sky like a great cloud, so that the day is darkened. When they see a green place, they

settle to feed. In a few minutes the green is all gone. The place is as brown and bare as if a fire had swept over it.

People hear with terror that the locusts are coming. They know the crops will be eaten up. Then food will be scarce, and the people will be poor.

If by chance a swarm is destroyed by other means than by fire, all the air for miles will be filled with the bad smell of the decaying bodies.

The only good that poor people can get from the locusts is by eating them. They pull off the wings, and legs, and dry the bodies. They eat them fried in oil and salt, or ground into meal, after roasting.

The locusts cannot fly against the wind. They go with the wind. It brings them, and if it changes, it sweeps them away. Sometimes the wind drives them out to sea. If they become too weary to fly, they drop into the waves and are drowned. This often happens. Then the water washes their bodies ashore. The coast of Africa has been found covered thick with them, for the space of fifty miles.

But they do not always drop into the sea. They are very strong on the wing. A great swarm of locusts was met by a ship, twelve hundred miles from shore. They surrounded the ship, and hid the sun.

As their flight is so strong, locusts can go from one country to another. They pass from Africa to the south of Europe. They go from the mainland to the islands.

Usually the locusts fly during the day, while the air is hot and dry. Late in the day they settle to feed, and where they stop they stay until all green things are eaten up. Of course they do not feed when on the wing. They run along the ground to eat.

People try many ways of killing locusts. Sometimes deep trenches are cut, and filled with water, so that the young unwinged locusts, as they run along the ground, will fall in and be drowned. But the locusts are in such numbers that the drowned ones soon fill the trenches. The others run safely over the dead bodies.

Sometimes great fires are lit across their path. Then the hordes of locusts crowd on, and at last, the fires are put out by the burned bodies. After that, the others pass on unhurt.

You must know that the young locust is quite as greedy, and as great a terror as his parents. In the larval and pupal states, they migrate as well as when they have wings. They seem born to eat and to travel. At this stage they go by walking. They march

in a solid column like soldiers. They move straight on, nothing turning them aside. Is a house in the way? Over it and into it they go. You know some ants move in swarms in this way.[1]

The locust, being larger, more numerous, and more greedy than the ants, do much harm. If they find a town in their path, through it they go. Countless numbers may be killed, but there are countless numbers to follow. Is a river in the way? Into it they tumble, and when enough dead bodies lie on the water to make a raft, the other locusts pass safely over.

One great trouble about the locust is, that when a full-grown swarm passes through a place the ground is left full of eggs. The next year these hatch, and the larvæ and pupæ eat up all that has grown since their parents ravaged the land.

Famines of two or three years duration have been caused in this way. You will not wonder at the strength of locusts and the amount of food they need, when I tell you that one kind is quite a foot broad from tip to tip of the wings.

The great foreign locusts are very splendid to look at. They are dressed like soldiers in crimson and blue. Their fierce eyes shine, and the rush

[1] See Nature Reader, No. 2. Lessons on Ants.

of their wings makes a sound like the coming of an army.

Did I not give this locust a good name, when I called him the robber cousin?

LESSON XIX.

THE MERRY COUSINS.

You have heard about the robber cousin of the Old Man of the Meadow. Now you shall hear about a very happy and harmless little cousin. Here he is!

Did you ever meet him in your walks? Did he ever come creeping out of a hole in the wall, or from a chink in the bricks in the hearth, and sit down by you before the fire?

Did you notice how he waved his long feelers gently in the heat, and seemed to bask in the glow as pussy does? If you were very still, perhaps all at once he burst into a shrill, gay little song.

Did you notice what a shining, dark-brown coat he had? Did you see that his tail had two long, stiff hairs, or bristles, spread out from each other? Did you think that they were like the long tail hairs of the bright and dainty May-fly? [1]

[1] See Nature Reader, No. 2. "Child of an Hour."

When you saw all this did you know your little friend well? Did you call him by his name, "How are you, Mr. Cricket"?

Ah, the cricket is a right-jolly little fellow; let us take a good look at him.

There are three kinds of crickets which we shall talk about. The house cricket, the field cricket, the mole cricket.

The body of the cricket is not so slender as that of the grasshopper, it is short and thick. It is much the shape of the first joint of your thumb. The color is a dark, glossy brown, sometimes almost black.

The feelers are very long, longer than the whole body. The eyes are large and round. The under wings are very large, much larger than the wing-cases. When they are folded up, they reach out beyond the covers and the body, in a long needle-like roll. It looks as if Mr. Cricket were carrying home something under his arm.

Near where the wing cover joins his body, Mr. Cricket has a little, thin drum-head for his music. He is very fond of making a noise. The French call him "Cri-cri"[1] from the sound he makes. We call him "cricket" for the same reason.

The cricket has strong jaws, sharp teeth, and a thick round tongue. His feet are not broad and thick,

[1] Pronounced *cree-cree.*

like the grasshoppers. He does not run up plants as the grasshopper does. The cricket runs about the ground. He has sharp, thin feet. Sometimes they have stiff hairs on them.

As he runs about the ground, his long feelers warn him of any danger in front. What do you think he has to tell him of danger behind? He has that pair of long, stiff tail hairs, which look so much like feelers.

Mrs. Cricket does not sing. It is Mr. Cricket that makes all the noise. How does he make it? He has three strong veins under his left wing cover. The largest of these is rough, like a file. This vein he uses as a man uses the bow of a violin.

When the rough vein is drawn across the right wing cover, all the cover trembles, or quivers, and gives out a sound, as when the bow is drawn over the strings of a violin.

The field cricket will sing all day. The house and mole crickets sing only at night.

Field crickets and house crickets are very much alike. The field cricket is darker than the house cricket. He is also noisy by day. In the winter he creeps into the earth and is torpid, unless the early cold kills him.

I think house crickets are field crickets that have taken

to living in doors. So, in course of time, they have changed a little. But they were all field crickets once.

Crickets are fond of moisture. They are thirsty creatures. They will drink any liquid left in their way. They drink water, milk, soup, tea, beer, vinegar, yeast. I have known them to come to my ink bottle to try to drink the ink! But that killed them!

Crickets eat vegetables. They like potato. They are greedy, and will eat whatever is in their way. They eat bread crumbs, soft grease, and are very fond of meat. They catch and eat small insects. They eat leather. Also they will eat woollen cloth, stockings, clothes.

Once our cook laid upon the grass a large piece of woollen blanket, on which she had spilled some bread sponge. She left it there thirty-six hours. When she went for it, the crickets had eaten nearly all of it. It was so full of holes it was like a net. There were more holes than there was blanket.

Crickets do not like to change their homes. They prefer to stay near where they were born. If you carry them away they will use their big wings to get home. Unless they fly to move from home to

home, they do not use their big wings very much. They walk, or hop.

The poets and story-tellers are very fond of crickets. Many people think it is lucky to have them sing in the hearth. But there is no luck about it. It is just pleasant and cheery to hear them sing.

In hot weather the house cricket sometimes goes into the garden to live. In October he comes in, and finds a home in the house-wall. He likes new houses where the mortar is not too hard for him to pull some of it out and make his little home. He chooses the kitchen and other well-warmed rooms to live in.

If the house is shut up and without fires for some days the cricket becomes torpid. What do you suppose these little fellows did before they found men to build houses for them?

In houses they keep quiet all day. They are timid things. Perhaps they sleep. At night they come out. One wise old man who wrote about crickets said that the tiny, new crickets came out on the hearth-stone by hundreds. They were about the size of fleas. He found all sizes at the same time. So he thought that they hatch at any time if they live in a warm place.

The field cricket makes his house in the earth. He

seeks a hot, sunny spot. Then he digs out a hole with his strong jaws. This hole is often from six to twelve inches deep.

The cricket is very timid and runs into his hole if any one comes by. But if he is not afraid, he sits in the door of his house to catch insects that come near. He also eats leaves and grass, that grow about his door.

Little French children fish for crickets by tying an ant to a thread and dropping it into the hole. You can also make Mr. Cricket come out, by poking a blade of grass into his hole. He runs up to see what is the matter.

Down in the bottom of the hole, Mrs. Cricket lays her eggs. They are fastened to each other, and to the ground by a kind of glue. She lays about three hundred eggs each year. She does not put them all in one place.

As soon as the larvæ come out of the eggs, they run up to the top of the ground. Each one then begins to dig a new burrow. Now and then they get tired of a burrow, and go off to make a new one.

The little crickets in the larva and pupa state look much like the grown ones, only they have no wings. When they are about half-grown, they hop about, and look, and act, much like tiny toads.

If the crickets come out of the egg in July, they will reach the perfect state the next May.

When they are full grown, they have wings, and can play a tune. They like that. They sit in their doors and sing.

In Spain, the people like the cricket's song so much that they keep crickets in little cages, to sing for them. If they have plenty to eat and drink, they will sing and be happy.

Each cricket will need a cage all for himself. Two crickets shut up together will fight, until one is dead. Crickets always live alone.

LESSON XX.

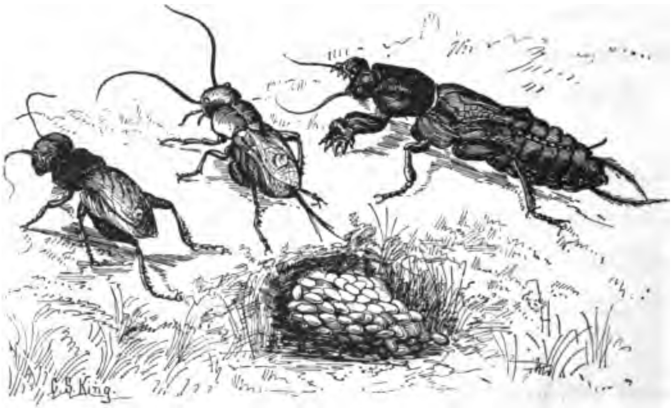
A QUEER CRICKET.

WHEN you are out in the woods, you may find a very small, brown cricket, in the moist places at the roots of trees. That is the wood cricket.

The most curious of all the crickets is the mole cricket. The mole cricket is the stoutest and largest of all the cricket family. He takes his name from the little furry, mouse-like animal that burrows in the ground, — the mole.

The mole cricket is something like the mole in shape, and in the shape of its front feet. It is very like the mole in its ways.

Mole crickets in the larva and pupa state are like their parents in looks and habits. They lack only the wings. The wings of mole crickets are short. They open and close them at each stroke when they fly. This makes them fly with a wave-like motion. Now they go up, now they drop down.



A HAPPY FAMILY.

The mole cricket sings only at night. It does not make such loud music as the field cricket.

The most curious thing about the mole cricket is its front feet. They are broad and short, and have toes. They look like a mole's front feet. They also look like the glove, or hand part, of a little suit of armor.

These hands are made for digging. The mole cricket burrows along under the ground as a mole does. Have you seen the long, low ridge of earth the mole makes in field or garden? The mole cricket's furrow is like that, only much smaller.

The mole cricket eats the roots of vegetables, as he goes along under ground. He is fond of peas, beans, and beets. He will eat the roots of flowers, also. He is a plague in a garden. He likes, also, to live near a stream or canal. He is very fond of damp places.

The mole cricket neither flies nor sings by day. If dug out of his burrow, he seems very stupid and helpless. At evening, he tries to comfort himself by a low, jarring song.

The mole cricket has a hard, shell-like body. Its legs also are horny. For this reason, one of its names is the "earth crab." It is of a lighter color than the other crickets.

Mrs. Mole Cricket makes a very pretty nest. It is the size and shape of half an egg, cut lengthwise. It is put very near the surface of the ground. Then the rays of the sun can warm the eggs.

Mrs. Cricket makes her nest soft and smooth. Then she puts into it about one hundred eggs. The eggs are in a tough skin, not a shell. They are

of a gray-yellow color. The earth above the nest often looks like an ant-hill.

Mrs. Cricket does not cease her care for her eggs, when they are put into the nest. There are some kinds of beetles that eat these eggs. Mrs. Cricket digs round and round her nest a net-work of halls. She hopes the beetle will get lost when he comes to look for her eggs.

After the eggs are laid, and the halls are all made, what do you think Mrs. Cricket does? She sits in one of her halls. She listens for Mr. Beetle or any other enemy. When he comes, she runs out to attack him. She fights so bravely that she drives him away.

At night, when the mole cricket is flying about, its body sometimes shines like fire. You know the firefly shines. But the firefly gives forth its light in flashes. The glow-worm has a steady light.

The mole cricket does not always shine. But some have been found to do so. People who have seen these big, bright things flying in the dark, have been so foolish as to get frightened.

I hope if you think of being afraid at any time, you will first make sure what it is that you are afraid of. The mole cricket is nothing to fear, even when he shines.

I think the reason that his body has been found to shine sometimes is this. He spends his time digging among dead wood and leaves. Sometimes he digs about dead animals.

Now, no doubt, there are times when in this work his body gets covered with a fire-shining stuff,[1] that comes among dead things. Then when he comes, fresh from his work, his body glows, and he shines as he flies. After a little, the shining matter wears off, and he shines no more.

LESSON XXI.

OTHER HOPPERS.

ONE day, when I was a child, I went to play in a field, with my brother. I saw that many blades of grass had little balls of foam on them. My brother said, "The horses have been eating here; ~~this~~ froth is from their mouths."

But when I had looked a little longer, I said, "There are no horses in this pasture. This grass has not been bitten."

A man who came by, said, "Ah, that is cuckoo spit. The cuckoos dropped it from their mouths." When the man had gone, I said, "Our father told

[1] The teacher might give examples of phosphorescent light.

me we had no cuckoos near here. And birds do not drop froth from their bills."

A little French boy, who had followed the man, said, "How silly that man is! That is frog spit! Frogs make it, not cuckoos." I told him, "There are no frogs in this field. I do not see one. But the froth is all over the grass."

"Since no one can suit you," said my brother, "you had better find out for yourself."

Then I took a leaf and laid on it some grass blades with the foam balls on them. And I gently opened the balls with a grass stem.

Oh here was a queer sight! Here was a little, live, pale, green thing. It had two tiny, black eyes, two little feelers, a body shaped like a three-cornered wedge.

"See, see!" I cried. "These balls are cradles! The grasshopper has made these beds for her babies. Here is a wee grasshopper in each one."

But it is very easy to be mistaken. I was wrong, too. For these little things were not grasshoppers, and they had made their foam balls for themselves.

Looking closer, we saw that the little green thing held fast by its head to the grass stem.

Then we saw that the foam ball being made of bubbles, changed and broke. You know bubbles do not

last long. These tiny bubbles slowly broke, and a clear drop of water ran to the bottom of the ball.

When the drop grew large, it fell off. Then another formed in its place.

We did not need to think long to be sure that the little hopper sucked sap, or juice, from the grass. This sap not only fed it, but ran through its body, and made its foam cloak, or bed. This kept it safe and warm.

When we learned more of these things, we found that these were not grasshoppers. They belong to another order of insects. I tell you about them now, lest you make the mistake that I did.

These insects are hoppers. Frog-hoppers some call them. Their hind legs are very strong. They make great leaps for their size.

There are a number of odd insects in this order.[1] They are very unlike each other, except in the wings. It is called the order of the same-wings, because the upper and under wings are alike. Only the upper ones are longer.

[1] Animals and plants are divided into Classes, Orders, and Families, that we may arrange and study them more readily. A Class contains many objects with some great points of resemblance — as the Class of Insects. The Orders bring those together which have yet more points of resemblance — as the Order of the Same-Wings. Families contain those yet more closely related — as the Aphis Family, the Frog-hopper Family. The Classes, Orders, and Families have Latin or Greek names, of which in this book we give only the meaning.

In this order you will find some of the fireflies. You know them. They fly about over the grass on summer nights. They make pretty little fireworks for you, before you go to bed.

The little aphis, which spoils the roses, is of this order. You know the ants keep the aphis for their cow, and eat the sweet juice it makes.[1]

We will look at only two of this family. We want to know a little about this wee frog-hopper. And we will learn a little about his biggest cousin, the cicada, or "the singer."

The hoppers have, also, a queer little cousin, the scale bug. The hopper draws out the plant sap, and covers its body with water. The scale bug turns the same sap into white dust. It covers its funny little body all over with flour!

Frog-hoppers are small insects. They have long feelers. They have only two joints in their feet. The frog-hopper has a big eye on each side of its head. It has, also, three simple eyes set on the top of its head, like this ∴

All the hoppers live on plant juice. The little ones are very greedy. The mother lays her tiny eggs in the plant. When the larvæ come out they fasten their mouths on the skin of the plant, and begin to suck sap.

[1] Nature Reader, No. 2, "Lessons on Ants," p. 29.

This bite of the hopper often makes ugly brown holes, or ridges, come on plants. Often the plants become sickly, and die, from loss of sap. The hoppers are not good friends of the plants, as the bees, ants, wasps, and birds are.

The largest of the same-wing order is the cicada. Did you ever hear him sing? Mrs. Cicada is quiet. Her mate sings all day. The hotter it is, and the drier, the more he sings. In all lands he is named from his noise, "the singer," "the screamer," "the squealer."

The cicada is a dry, horny insect. He will keep well in a cabinet. He lives in trees. Mrs. Cicada has no music, but she has a sharp knife. How does she use that?

We might as well call her knife an awl, or a gimlet, for it is like all three. It is used to cut, or bore, a hole in the tree. Into the hole she puts her eggs.

This tool which Mrs. Cicada carries has three blades. The outer ones are rough on the edges. They can cut into very hard wood. Mrs. Cicada takes hold of the tree bark with her front feet. Then she cuts away with her knife, until she has made a neat little furrow.

She chooses a dead branch for this. The sap in a live branch would harm her eggs.

When the larvæ come out of the eggs, they at once leave the hole, and drop to the ground. There they dig a little house for a home. Their fore feet are well made for digging.

Underground they feed on roots. They change from larvæ to pupæ. Next summer they come up, full-grown. Then Mr. Cicada begins his song. Mrs. Cicada at once goes to work to cut holes for her eggs.

When, in mid-summer, the shrill song of the cicada is heard, people say: "Ah, now it will be hot and dry!" The poets have always loved the cicada, and made many pretty songs and stories about him.

LESSON XXII.

REAL LIVE FAIRY.

One September morning I took Hermie, and went over the hill, to the windmill. The hillside was covered with wild carrot, golden-rod, asters, white, purple, and pink. Near the windmill was a late wild-rose, in full bloom.

Right in the golden centre of the rose, on the stamens and pistils, I saw what might be two fine jewels, and the coiled-up spring of a fairy watch. On the

ground, among the rose-leaves, lay four lovely fans, in black and gold. They looked as if the fairy-queen and her court ladies might have dropped them, as they came home late from a ball.

I put all these things on a piece of white paper. Then I sat on a stone, took out my microscope, and said to Hermie, "Look here!"

"O!" cried Hermie, "these are the head and wings of a poor butterfly! But where is his body gone?"

"A bird has eaten it," I said; "see, the bird's bill has ta-

THE LIGHT BRIGADE.

ken in the body and clipped off the wings, and just missed the head, which has dropped off. These are not the relics of a fairy ball, but of a cruel murder."

"I do not see," said Hermie, "how a butterfly, which flits so fast, could be picked up so."

We looked about the leaves of a wild-carrot, and, on the under side of two or three, safe from the wet, we found a cluster of pale greenish eggs. "See," I said, "the bird dipped down, and picked up the butterfly, while it was clinging to the leaf, laying its eggs.

"Or, perhaps the eggs were all laid, and the butterfly was resting on the bush. Many of these insects die, soon after the eggs are laid. When the eggs are safely placed, the insect seems to feel tired and dull."

Then we looked at the black and yellow wings through the microscope. "See all these little scales and plumes!" said Hermie. "They lie thick as a bird's feathers! Once I put a butterfly in a box. When I let him out, the box was all dusted over with gold dust. But the butterfly did not look *bare*. He seemed as well dressed as ever."

Then we looked at the head. "What big eyes!" said Hermie, "and that curled-up thing is his mouth.

I have seen him drinking with it out of flowers. I do think butterflies are the prettiest things that are made!"

Many persons think the butterflies are the most beautiful of all the insects. Next to the beetles they are the most numerous order. They have, also, been the most studied. Let us look at them a little.

The butterflies belong to the great order of the scale-wings. To this order belong two groups of very beautiful insects. We will look at them. They are the butterflies and the moths.

The butterflies are insects of the day. The moths are generally insects of the night. Even when the moths fly by day they can be easily known from the butterflies. The butterfly always has a knob or a point on the end of his horns. The ends of the moth's horns are pointed.

When the butterfly is at rest, his wings are held up and laid flat against each other. Thus the top sides are hidden, and the under sides show. His wings are called vans.

The moth rests with his wings folded along his body or laid out flat. They cling close to what he rests upon. If they bend at all, they bend downward, not upward. The body of the moth is shorter and thicker, more wedge-shaped, than that of the butterfly.

Now, for a look at our butterfly. The head is small and moves freely. It is not set in a socket to the body, but held by a little neck. On each side of the head is a great, bright eye with many thousand facets, or surfaces.

At the back of the head of a butterfly are generally two small, simple eyes. These are usually hidden under long hairs. Do you see the soft hairs which clothe all the butterfly's body? For you must notice that the butterfly wears an elegant, soft, velvet coat of fine hairs. This coat is usually black or brown. But it has often stripes or spots of a lighter color.

On the top of the head the butterfly carries a pair of many-jointed horns. As I told you, the ends of these are little knobs.

The chief part of the mouth of the butterfly is a tube, called a trunk. Did you ever notice the big trunk of an elephant? The butterfly's trunk is small. It is coiled up like a watch-spring when it is not in use. The butterfly can unroll it. It is so slim he can thrust it into the longest and narrowest flower cups.

Really this trunk is made of two pieces with little points upon them. These two parts lie together and seem one. Between them the honey is drawn

up. You must know that butterflies live chiefly on honey. It is not likely that they take much other kind of food, but they are fond of water. Have you seen them in damp places?

When the fine trunk of the butterfly is curled up it is kept safe by two hairy pieces which grow on the front of the head.

The butterfly has six legs that grow from the chest part of its body. But the butterfly is not a walking insect. Bees, wasps, ants, and beetles, you know, walk a great deal. Butterflies rarely use their legs for anything but standing when they eat or rest. They move only by flying.

The wings are made of two thin skin-pieces laid upon a framework of nerves or veins. They are covered with a double layer of scales. The edge scales are long and fringe-like. The upper and under sides of the wings differ in color.

The upper wings are widest. They have smooth edges, and are of a triangle-shape. The lower wings are rounded. They have waved or pointed edges. Sometimes they have two long points like tails.

The body of the butterfly is made in rings, but they are soft, not horny like those of a dragon-fly. The body is slender and has no weapon. It has no sting to fight, and no saw to cut wood to make a place for its eggs.

THE LITTLE PRISON.

LESSON XXIII.

THE CHILD OF THE DAY.

THE butterfly is the chief partner of the flowers. Its long, slim drinking tube helps it to dip far into a flower's throat. As it reaches in, it gets the stamen pollen well upon it. Then, since the butterfly rarely walks about, as the beetles do, it is not likely to waste the pollen by rubbing it off where it is not wanted.

Not only is the butterfly the flower's best partner, but it wears the gay colors of the flowers. Once I was walking in a garden with a very little boy.

A flight of yellow butterflies came over a tulip bed. "See! see!" cried the child, "the flowers are loose, and are flying away!" Poets, as well as children, have called the butterflies "flying flowers."

In very early times, people began to study butterflies. It was not only their number or their beauty which made people notice them. It was the wonder of their changes, from egg to full-grown insect.

Who would think that this splendid thing, which scorns to use its feet, and lives on the wing in the clear air, was once a worm, crawling on many legs, among the grasses and leaves?

Who would think that this dainty creature, which drinks dew and honey, once spent all its days, chewing and gnawing leaves as the earthworm does?

Who would think that these bright wings, which are so crisp and stiff that they never bend or wrinkle even by a single fold, were once like little flat buds, inside a crawling caterpillar, or bound up in the tight, horny pupa case?

Let us follow the journey of these little greenish eggs, stuck on the under side of a carrot leaf. Let us follow them up their curious way, until we see

them sitting on the heart of a rose, as on a throne of gold, and then suddenly sailing off among the sunbeams!

Each kind of butterfly prefers some especial plant, on which the caterpillar feeds. On this plant the eggs are laid. Some butterflies like oaks best; some cabbage; some choose plants of the carrot family for a home.

The butterfly which we will now hear about is the "swallow-tail." It is one which likes fennel and wild carrot. It lays its eggs on the under side of the leaf of one of these plants. The eggs are placed in little patches. They are of a greenish color, and nearly round. The eggs of some other butterflies are of very odd shapes.

The first eggs of the swallow-tail butterfly are laid in May. In eight or ten days the eggs turn nearly black. Then out comes the little caterpillar. The first thing he does is to turn around and eat up his shell! Next he begins to eat carrot leaf. He grows, and in a few days casts his skin.

The caterpillar keeps on growing. To get more room he sheds his skin. He eats the cast-off skin each time. He is a very pretty caterpillar. His color is bright green. On each of his twelve rings he has a black band. On each black band there are

gay, yellow spots. He is about an inch and a half long when full grown.

There is a queer thing about this caterpillar. If you touch him, while he eats, he runs out a little forked horn from behind his head. He seems to want to frighten you! When you let him alone he draws in his horns. These horns can emit a strong smell.

His feet are made with rings and hairs, so that he can creep safely along the plants where he feeds. His mouth is weak, so he can eat only soft leaves. In about two weeks he has eaten all that he needs.

Then he creeps up a plant stem and spins a strong silk rope. He binds this rope about his body and the plant stem. That ties him fast. The caterpillars of several kinds, which tie themselves in this way for the pupa state, are called girdle caterpillars, or belted caterpillars. He is also held fast by the tail as well as by this body belt. When he is tied, his body shortens and thickens. His caterpillar skin bursts, and drops off.

He is now a pupa. The pupa skin hardens into a little case. Now he neither moves nor eats.

How long is he a pupa? That depends upon the time of year. In spring, two weeks are enough for the change. In hot summer, nine days or a week will

do. If it is cold autumn weather, the pupa will not change to a full-grown insect until the next spring.

If in the winter you find a pupa tied to a weed, and bring it into a hot-house, or a warm room, in a few days you will have a fine butterfly out. A wise man, who studied butterflies, put some pupæ in a very cold place, and they did not change for two or three years!

When it is time for the insect to come out of the pupa case, some motions like deep breathing are made. These crack open the hard skin. Then the insect pulls itself out. It is moist and weak. Its wings droop a little.

The new butterfly breathes hard, many times. At each breath air rushes through its body, and through the tubes of its wings. The frame of its wings stiffens and fills out. The body and legs grow dry and firm.[1]

Then the new-made butterfly rests a little, — perhaps for several hours. After that it seems to feel fine. It can move its wide wings! It can fly! It sails away!

Now it lights on a great white head of wild carrot, or on a rose. Let us look at it. Its wings are black

[1] See Nature Reader, No. 2, Lesson 45.

and yellow. The black is in bands and streaks. It has six bluish spots on each lower wing, and one large red and blue spot. Its body is like black velvet. Each lower wing has a long, beautiful, curved tail.

The butterfly is an insect with fâr more beauty than sense. We may say it is an insect with very little brains. It has none of the wise ways of the ant, wasp, bee or spider; it only flies and eats, and lays eggs. It builds no house, stores no food, takes no care of its young.

The butterfly can see. It has wonderful eyes. It can hear. It can smell. It can taste. Its flower partners spread out for it their finest colors, perfumes, and honey drops.

LESSON XXIV.

LIFE AMONG SNOW AND ROSES.

I TOLD you that the butterfly did no work, built no house, and showed very little sense. That is true of the full-grown butterfly. He seems so pleased with his wings that he does nothing but enjoy them.

But you must know that the caterpillar is only one state of the butterfly, and there are caterpillars which build for themselves very curious houses.

A FROSTY MORNING.

There are caterpillars which leave the egg in the autumn. They live as caterpillars all winter, and enter the pupa state in the spring. Let us watch them, as they live with the snow-flakes flying about them. Then we will watch them to the time of roses.

Many butterflies lay their eggs singly. They put one egg alone, on the tip of a willow, hazel, poplar, or oak leaf. Other butterflies put their eggs in small clusters on the underside of carrot, nettle, or blackberry leaves. Some put eggs in a ring, around an elm or birch twig.

Now and then you find the eggs in a chain or pyramid, hanging upon a leaf.

There are, also, some butterflies which drop their eggs on the ground among the grasses, or on the lower parts of grass blades.

In all cases the caterpillar feeds on the plant on which he is hatched from the egg. When he is ready to come out of the egg all he has to do is to bite a hole in his shell and crawl forth. Then, at once, he begins to eat.

He may begin at the tip of the leaf, and eat up to the mid-vein on both sides. He is careful not to bite the mid-vein. When he has had a full meal, he goes and lies along the mid-vein to rest. Then, when rested, he eats again. Many do this, but not all.

When one leaf is finished, he takes the next one on the twig. After the first leaf he is not so careful to begin at the tip. He just bites out pieces anywhere, but he does not bite the big vein. Perhaps it is too hard. Perhaps he knows he must have it for a road-way.

Do you remember what you read in the First Nature Reader about the spider, which has in her body little knobs for spinning silk?[1] The caterpillar has a silk-spinner. It is in the underside of his head. It is a little tube in the shape of a cone.

[1] Nature Reader, No. 1, p. 54.

Did you ever notice the queer way a caterpillar has of wagging his head from side to side? He acts as if in great pain. But he is not in pain. He is only laying down a silk web with that motion.

It is by means of this silk that the caterpillar makes his home. Let us look at him while he works. He fastens his line to the edge of a leaf. Then he carries it to the other edge, or to the next leaf. Then another line, and so on. Each line is a little shorter than the one before. This bends the leaf. At last it is bent into a tube, or box, or several leaves are bound into a bower.

The caterpillar bites a notch, or line, in the tip of the leaf to make it bend over for a roof. Is not that cunning? Think how strange it is, that a tiny thing, just out of the egg, away up alone on a tree, should know how to build this pretty house!

The caterpillar of the swallow-tail chooses a leaf for a home, weaves a silk carpet over it, and lies along the mid-vein. What do you think he does on rainy days, when the water begins to take his bent leaf for a spout or gutter?

He builds a second floor of silk, a little higher up, between the edges of the leaf. That makes a nice, dry, silk hammock. There he lies, while the water ripples along the mid-vein below him. I suppose the sound of the water sings him to sleep.

A caterpillar which makes a bag of a nettle leaf, for a nest, lies in it so snug that he is too lazy to go out for food. So he eats up his roof for his dinner! Another caterpillar draws a leaf together into a pretty little pocket. He weaves silk over it, outside and in, and then,—he eats up this dear little home, and has to make another!

These caterpillars make their homes for summer. There are some which need winter homes. The caterpillar of the Viceroy butterfly is only half-grown when winter comes. He lives in a willow-tree. He makes his warm winter house of a willow leaf.

How does he do it? He eats part of the leaf away to the mid-vein. Then he bends the lower part together, with silk. He fastens the edges tight and lines the inside with silk. Then he covers the outside with silk, and binds the nest to the twig with a silk thread, by crawling around and around, drawing the silk with him.

The fierce winter storms will not tear off this house, which he has bound to the tree. The silk he uses is of a brown, dry-leaf color. When the house is made, he crawls in, head first. The knobbed hind end of his body fills up the open part of the nest. Did you ever hear of caterpillars called "woolly-bears," because of their furry bodies?

This caterpillar has a little cousin, who makes his winter home of a bent birch leaf. The color of his silk, and the knobbed end of his body, are just the gray-purple of young birch buds. So, in the spring, no bird notices him. Thus, while the snow flies, these caterpillars lie safe in their warm homes. They are torpid.

Early in the spring they become pupæ, and then butterflies. Some butterflies pass the winter as eggs, some as caterpillars, some as pupæ. Some butterflies have two or more broods in the summer. Thus we have new butterflies every week.

Full-grown butterflies sometimes live over winter. They come out in the spring, looking rather shabby, and with the edges of their wings broken. When frost comes, they creep into some crack, or under a piece of tree-bark, or down among the roots. As they lay their wings flat against each other, a small crevice will hold them.

But the glad time of the butterflies is in the summer, when they have wings, honey, and sunshine. Some live from May until September. Some come out in April, and live only through May. Some wait until July and August. Others come for a little time in the spring, and a second brood in October. Of these many lie torpid in cracks over winter.

At night, and during rainy days, butterflies hide, as they do in cold weather. They seldom fly abroad before nine in the morning. Between four and five in the afternoon they begin to steal off to bed. They are out in full force in those bright, hot noon hours, when the flowers are at their best. Happy butterfly, he flits about in the sun and drinks honey all the time of roses!

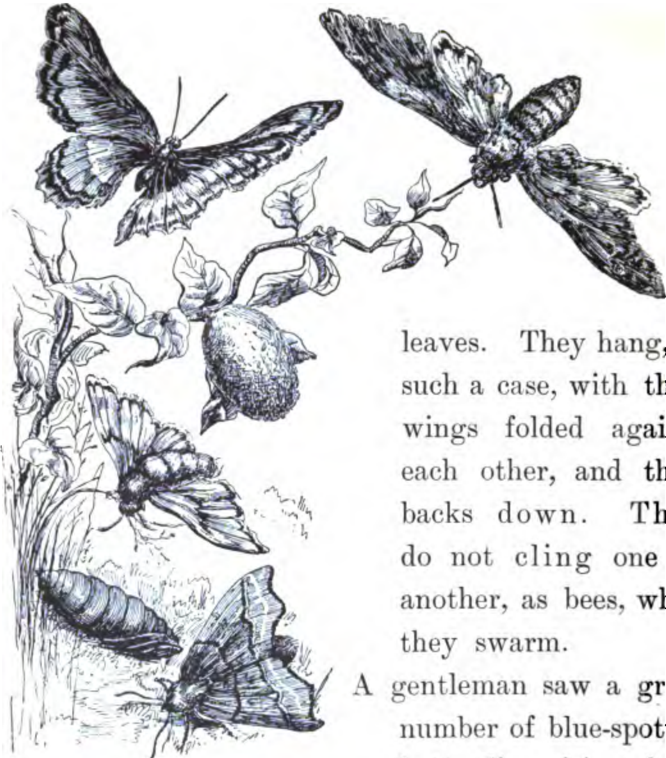
LESSON XXV.

JOSEPH'S COAT.

Many butterflies live alone. But some seem to go in what we call a swarm. A "flight" of butterflies is a better name for many together than "a swarm." It is more common to see a number of caterpillars together than many butterflies. The large, gay-colored butterflies are generally seen only by one, two, or three, at a time.

No doubt you have seen a piece of damp ground, which looks as if it had burst into blossom, so many yellow butterflies have lit upon it. They are fond of moisture.

Orange-and-black butterflies have been seen to settle on a dead bush, and cover its branches like gay



AS NIGHT DRAWS NEAR.

leaves. They hang, in such a case, with their wings folded against each other, and their backs down. They do not cling one to another, as bees, when they swarm.

A gentleman saw a great number of blue-spotted butterflies, rising from some low pine-trees, where they seemed to have spent the night. Another gentleman saw a very great swarm of the orange-and-black butterfly, which hovers about the milk-weed. Hundreds of small, copper-red butterflies sometimes light together on a hot, dusty road. Even the fine swallow-tails have been seen

in numbers together, when attracted by the honey and perfume of a lilac-bush.

Some butterflies eat less than others, and spend much time sitting in the sun, opening and shutting their vans or wings. They seem very fond of play. You will see them whirling about, and chasing each other, like children at a good game.

Some butterflies have a way of flying at whatever they see in motion. If you toss a glove, ball, or little basket, into the air, they dart at it. They seem curious to know what it is. Did you ever see a little copper-colored butterfly, with black spots, darting at a big beetle or grasshopper?

These little fellows seem to lie in wait under the leaves, and rush out at whatever goes by, just as little dogs dash out from gate-ways!

Let us now talk a little about the colors of butterflies. The upper and under sides of the wings often differ much. The upper side is much brighter than the under side. Do you see a reason for this?

The insect flies with the wings spread out in full view. Its flight is not even and straight. It moves in jerks, called "flitting," and it dashes here and there, zig-zag. This way of flying makes it very difficult for a bird to pick up a butterfly on the wing.

Thus the pretty insect is safe enough when he flies. But it would be easy to pick him up when

he lights. So the upper side of his wings shows most of his beauty, and the under side, which only is shown when he rests, is shaded like a dry leaf, or is of the hue of the plants upon which he often sits.

Not only is the butterfly protected by the graver color of the under side of its vans, but it wears the general flower-color of the season, or of its home.

In spring, you know how many of the flowers are blue, or partly blue. The violets, the hyacinths, the purple crocus, the liverwort, and many more, are blue, and among them fly blue butterflies. There are more blue ones in spring, than at any other time of year.

Also, in spring, there are many yellow butterflies. You will hardly be able to distinguish them at first glance, from the buttercups, dandelions, crocuses, and cowslips, upon which they rest.

The little butterflies, which love the dusky woods, are brown, drab, and gray, with black or reddish spots, and dull, yellow marks. Their coats are like the colors of the tree trunks, the mosses, and dead leaves, where they live.

Then when the daisies and lilies are wide out, with the white roses and bright-hued summer flowers, come the white butterflies. With them follow the

splendid swallow-tail family, to swing around the tulips and gladiolas, and petunias, yellow lilies, and geraniums.

In the autumn, among the marigolds, dahlias, and asters, all our gayest-coated butterflies come out, — orange, gold, brown, scarlet, purple, — eyed like peacocks' tails.

You must not think from this, that you will see *only* such and such colored butterflies, at certain times of year. You may see swallow-tails very early in spring. They have lived over winter.[1] You may see in autumn the second brood of spring butterflies. You may find the autumn butterflies sailing about in the summer. They have lived over winter as caterpillars.

A little lad said to me, one day, when he saw a very gay peacock butterfly, "I think Nature got tired of painting, and emptied her whole paint-box on that fellow!" Indeed, it does seem as if there is no gay tint of earth, or sky, or sea, no hue of flower, or rainbow, which the butterfly does not wear.

They come to us in red, purple, green, blue, white, black. They take all shades of these colors. Then the colors are put on in lines, dots, streaks, bars, spots, fringes. They are made more beautiful by

[1] North of New Jersey and Pennsylvania, the swallow-tails never live over winter.

the waved line of the lower wings, by the velvet body, the slender legs, the graceful feelers, the bright, jewel-like eyes.

No silk dyer can bring out a new shade, but some butterfly has worn it for his every-day clothes, since the creation. No king can buy any richer colors, or more finely put together, than our butterfly wears. And all else about him sets off the splendor of Joseph's coat.

LESSON XXVI.

COUSIN MOTH.

A LOWLY LIFE.

In the great order of the scale-wings, the butterfly is of the family of the "club-horns." His cousin, the moth, is of the family of the "varied-horns."

The feelers of the butterfly, up to the club, are straight and smooth. The feelers of the moth are curved and often fringed. If you put them under a strong microscope, you might think you were looking at lovely ferns.

Do you remember what you read in the first and second book of Nature Readers, of the hook-wing family? Almost all moths have a hook and catch to fasten the lower wing to the upper one in flight. No butterfly has such a hook.

I shall now tell you about cousin moth. He is the night flyer, with the big, thick body, the furry coat, the fancy feelers, the hook for his wings. He is the flyer that rests with his wings laid open and flat, or laid close down along the sides of his body, like a cloak.

The moth often flies by day. He has lovely, painted wings, but they do not *gleam* as do those of the butterfly.

"I do not want to hear about moths," said a little girl; "I know all about *them*. I kill all I can see. I killed a big, white one, last night. They do so much harm. They ate up my mother's best muff!"

"And did you kill the tiny, silvery-looking moth, which was flying close to the carpet? He is a little fel-

low, who when he lights, is folded into a roll, not so long as the nail of your little finger."

"No," says the little girl; "he is too little to do any harm. I let him alone."

"Alas! my child. How easy it is, in this world, to be mistaken! How often the innocent suffer for the guilty! That silent, white creature, looking like the ghost of a lily, never has done any harm. That little silver roll is the meddler, who, in his early days, ate up your mother's muff! Come, I see you know nothing about moths."

As we sat on the porch, last night, some one said, "Who ever before saw a humming-bird flying at night? There is one now, at the honey-suckles." No! it was not a humming-bird, but a large hawk-moth. He hung poised on his quivering wings, unrolled his long trunk, thrust it deep into a flower, and drank honey.

It was hard to distinguish him from a humming-bird. Then, as he dashed across a moonlit space, he looked like the swallows we had watched at sunset.

The hawk-moths are large, with large furry bodies. They have a swift, bird-like flight. One of the largest is called the "death's head." He is furry, even to his wings and legs. On his shoulders he has black and white marks, like a skull.

The caterpillar of this moth is the largest of caterpillars. It is four inches long, and as thick as a man's finger. Its color is green, gray, and yellow, with black dots. It lives on potato-vines. It has bluish stripes on the sides.

If you find one, you can raise a moth from it. You must keep it in a dark place, give it potato leaves to eat, and some moist earth to burrow in. For this caterpillar hides in the ground, to spend his pupa days. The pupa case looks, I think, much like a sea-shell.

A queer thing about this moth is, that it can squeak. If you touch its feet, with a bit of stick, it seems angry. It crouches down, and gives a squeak. No one knows how it makes this noise.

Another curious moth is the wasp moth. It is a day-flyer. It loves the hottest noons. It does not look much like a moth. It looks like a wasp, or hornet. Its body is slim, and has yellow and black bands. Its wings have very few scales. The wings are thin and clear, like those of a wasp.

These wasp moths live about trees and shrubs. They lay their eggs under the bark.

The caterpillars are able to eat wood. They gnaw the wood for food, and so dig their way into the trees, and live there. When they have eaten all they

want, they have made a nice little hole in the tree. They line it with silk. Then they fall asleep in their pupa state.

When they are ready to come out, they do not leave their hard pupa case in the tree. They need it to protect their wings, as they creep out. When they get to the door of the hole, they pull their bodies out of the case. Then they fly off, and leave the pupa case sticking in the hole.

The most useful moth, one worth all the rest, is the bombyx. He made your mother's silk dress, and your hair ribbon. "What!" Well, did you never hear of the silk-worm? The silk-worm is the caterpillar of a moth.

This is a dull, plain, little insect. Its trunk is very short, in fact, it is almost gone, for this moth never eats. It is very short-lived. All it lives for is to lay a great many hundred eggs.

These eggs are laid on mulberry trees. The caterpillar soon hatches from the egg. It is a small, homely thing. It eats much during thirty days. In one thing it is different from all other caterpillars. It has a much better silk-spinner in its head. It makes a great deal of strong, yellow silk. Its body seems full of the sticky stuff, which, when it is drawn out, hardens into silk.

Of this silk the caterpillar spins its cocoon. It spins hundreds of yards of fine, silk thread. Then it wraps itself in a cocoon and casts off its caterpillar skin. If left alone in the cocoon, it eats its way out, when it has become a full-grown moth.

You must ask your mother or teacher to tell you how this ball of silk is turned into ribbons and dresses.

From the moth which makes silk for our clothes, let us turn to the moth which eats up our fur and woollen clothes. The name of this little plague is *Tinea*. You might as well call him *tiny*, for he is the least of all moths. He looks as harmless as possible.

He is a mere little silvery, fringy roll, hiding in shady places, or flitting low and silently on his little gray wings.

But little Mrs. Tiny, whose name *tinea* means that she is a spoiler of things, lays hundreds of eggs. She hides her eggs in carpets, curtains, furniture, and clothes. As soon as the little caterpillar is out of the egg, it proceeds to gnaw what it is lying on.

This small creature bites and pulls out hairs, or threads, and weaves for itself a nice little rainbow case. As it grows larger, it builds more case with more threads. As these hairs or threads are stolen out of our best things, soon we find great holes in our coats and gowns.

Shake the clothes, and out fall hundreds of little larvæ, or wee caterpillars. When the case is all finished the caterpillar likes to hang it up by the closed end. Then he hangs in it head downward, as a pupa. The case looks like a little roll of dust and fuzz. But the fuzzy end is the head of little *tinea*, living out his pupa days.

LESSON XXVII.

THE CHILD OF THE NIGHT.

I SUPPOSE you have seen great cobweb-like nests, hanging on plum, cherry, and apple trees. You have heard them called "worm nests." You have seen that they are full of brown caterpillars, about an inch long.

If you had looked at the twigs of these trees, just after the leaves fall in the autumn, you might have thought some fairy had been putting belts and bracelets upon them. Around the twigs were little even bands of beads. These beads were the eggs of a moth.

As soon as the caterpillars come out of these eggs, they unite in spinning their large silken nests, or tents.

There they live together, until they have grown to nearly full size. Then they bite holes in the nest and travel off, each its own way.

When the caterpillar is full-grown, it spins a nice, thin, clear cocoon, and powders it all over with yellow dust.

When the moth comes out, it has yellowish wings with brown bands. It appears in July, and at once goes off to the orchards. There, in the autumn, it lays its eggs in rings around the twigs. This moth rests with its wings folded against its body like a cloak. Many moths fold their wings cloak-wise, instead of spreading them out flat, when they rest.

There is a very beautiful large moth, which has a curious caterpillar, about which I must tell you. Whenever this caterpillar changes his skin, he puts on a new color. At first he is black, and so hairy that he looks like a little hedgehog. His next skin is a gray-green, with jet-black hairs and dots. The third skin is light green, with five rows of black dots, a number of clear, yellow spots, and two splendid red spots, like buttons.

The fourth coat is blue, with black and red buttons. Then his last coat is green, with orange buttons. He now spins a cocoon. It is double. The outside

is tough and skin-like. The inner part is of softest silk. This caterpillar is found in the south.

I should like you to see the caterpillars of the sphinx moth eating. This moth gets its name from an odd way the caterpillar has of resting. It lifts up about half of its body, and holds it stiff, and quite still. People think it looks like a great stone image in Egypt called the sphinx.

The sphinx moth lays its eggs on the top sprays of a weed called the spurge. This weed has a milky juice. The seed grows in a little nut-like pod or case. The caterpillar of the sphinx hatches from the egg among the tender green top leaves. These will make its food. At once it begins to eat. It grows fast. As it is greedy, and likes spurge, it eats up all the plant but the roots.

The caterpillar eats the plant from the top down. When it comes to a seed pod it seems to say, "Now for a treat!" It sits up in its funny way, and takes a seed case between its front feet, as a monkey would hold a nut in its paws. It holds the pod against its mouth with its front feet, and gnaws away at it, until it is all gone.

When one plant is stripped bare, off the caterpillars go to another. There they begin at the lower leaves, and eat upward. The lower leaves are coarse and

hard. Why do they eat them? Why do they not climb up for better leaves?

Do you not see the wisdom of this habit, which has been fixed in these little creatures? If they climbed up, and ate the top leaves, their little brothers up there would have nothing to eat when they came from the egg. Then they would starve.

If you poke one of these caterpillars, while it is eating, it seems to be very angry. It spits out a quantity of green, ill-smelling juice. But the sphinx caterpillars are pretty, if they have not very good manners. They are black, or dark green, with crimson lines like ribbons on them. They are dotted all over with spots like pearls.

They are full-grown in July. Then they creep into the ground for their pupa state. They lie there, shut up in shell-like cases. In a few weeks, out come the moths. Very early in the day, or late in the afternoon, you may see them flying about honey-bearing plants.

This moth is very pretty. It has large wings of a rose color, with black and green wavy bands. There are two broods of them each season. The caterpillars come in June and September. At the end of September, the last brood of caterpillars hides

in the ground to spend the winter in the pupa state.

All moths that fly in the evening are attracted by light. If you wish to see what very beautiful creatures they are, set some plates on a table around a bright light. Have some glasses ready, and open the window, or outside door. You will do well to have some ether and some cotton wool.

In come the moths! As they blunder about the light, it is easy to catch them gently, and put them on a plate under a glass. Then put in a bit of wool wet with ether, and they will soon be dead. Or, you can look at them awhile, and then let them go. If a moth falls on the velvet or woollen table-cover, you will see the cloth covered with gold dust. These tiny dust grains are his scales.

You will wonder at the beauty of these insects. They have silver and gold gleams. Even the smallest are lovely. Many of them are dressed in pea-green and silver, or rose-pink, with red, black, and brown lines, and fringes. Some are lemon or orange color. I have found very lovely little moths, clinging to the window panes, early in the morning.

The moths of tropic lands are very large, and very splendid in their colors. I do not think they are

prettier than many of those in our own land. Our moon moth has long tails, even longer and more curved than those of the swallow-tail butterfly. It is of a delicate cream color, with pink spots.

Now, I will tell you how to catch night-flying moths, if you wish to make a collection. But do not take more than one or two of a kind. It is cruel to waste life.

A collection of moths is hard to keep, their bodies are so soft and large.

If you wish to catch night moths, take some brown sugar and boil it to a thick syrup. Put in it some peppermint, or rose water, or vanilla, to make it smell nice. Soak some white rags in it. Then lay the rags in a bowl. Put plenty of pins on your sleeve. Have some boxes to put the moths in, and some ether to kill them.

You should have your *net* along. You know a net to catch insects is a bag of lace, or fine netting, sewed on a hoop with a handle. You need a short handle in the night-moth net.

Go to a clump of trees, and pin the sugared rags on the trunks. When you have pinned on all you wish, turn about, and go to the trees where you put the rags. Have your lantern along. You

will see dozens of moths feasting on the sugar in the rags. You can catch as many as you like, and put them in your boxes.

LESSON XXVIII.

THE BIRD.

ON THE WING.

A BIRD is an animal which comes from an egg, wears feathers, and is built for flying. Even the few birds which run, and do not fly, are all built on the general plan of flyers.

An egg was described in lesson seven of this book. All of you have seen plenty of eggs. The eggs of birds are usually hatched by the mother-bird sitting upon them for a certain number of days, or weeks, and keeping them warm with her body.

Some few birds, as the ostrich, hide their eggs in the sand to be hatched by sun heat. One or two other kinds of birds hide their eggs in earth or leaves.

I shall tell you of only a few things about the bird's body. I wish to tell you just enough about birds to interest you, so that you will try to learn more about them.

The first thing for you to notice about the body of the bird is, that it is built for lightness. The bones are thin, and most of them are hollow. Your bones, and the bones of four-legged animals, are either solid, or hollow and filled in the centre with marrow. But the bird's bones are made to give it the greatest possible size, with the least possible weight.

Not only are the bird's bones hollow, but it is able to send warm air from its lungs through them. Thus they not only do not weigh the bird down, but really help to keep it up in the air.

The bird has more bones in its neck than men or beasts have. The bird's neck is long, and bends easily. Its head and neck divide the air before it as it flies. Even birds which look short-necked have really more bones in the back of the neck than you have. They owe the short look to the feathers.

The body of the bird is built on the *boat plan.* It is an air-boat. Its breast-bone serves as a keel. It is placed low down, and is large and sharp. In very strong, flying birds, as the eagle, this keel is very large. To this are fastened the many strong muscles which move the wings. The few birds which do not fly, as the ostrich and penguin, have the breast-bone flattened or "raft-shape."

The ribs of the bird form a large, light, boat-shaped frame. Its tail is made of a number of back-bone pieces, crowded close together. This tail moves easily, and serves the bird as a rudder, to steer and steady its way through the air.

If you strip all the meat off a chicken's wing-bones, you will see a kind of a rude pattern of a man's arm and hand, with a thumb and two fingers. The length of the wing usually depends on the length of the upper wing-bone. But in humming-birds and swifts, the lower part of the wing is the longer.

In some birds, the wing, when spread out, is much longer than all the body. The wing folds up, something like a crab's claw, or as you would shut a knife. In birds that are walkers, and not flyers, the first wing-bone is short. The penguin, which never flies, has a little short wing, which looks like a hand, without any arm.

Now, we come to the bird's legs. In your leg, the thigh-bone, the one from the hip to the knee, is the longest. In birds, it is the shortest. Even in very long-legged birds, as the stork, the thigh-bone is short. The length comes in the bone from the knee to the foot.

Thus, when the bird flies, its large, hollow, air-filled thigh-bone is drawn up to the body, and the lower part of the leg is held backward, and does not hinder the flight.

The foot of most birds has four toes. But some, as the ostrich, have less. I shall talk to you about feet in the next lesson.

The first thing you notice about the bird's head is the beak. I shall tell you about beaks, also, in the next lesson. Now, I shall only say, that the beak is the horny, outer end of the jaw-bone. Birds never have any teeth. The beak often forms the larger part of the bird's head. The head is small for the body, and nearly flat on top.

When you see a bird with two things like horns on its head, as some owls have, do not think that they are either horns or ears. Birds have no horns. These things are just feather head-dresses. Birds have ears, but the ear-hole is hidden under the feathers. Birds have very keen sight, very keen

power of smell.[1] They have loud, clear voices. Many of them have very sweet voices. I suppose they have as good a sense of taste as we have. I notice that parrots like sugar and cake, and many birds like fruit.

What do birds have instead of teeth? They have inside of the body a gizzard. It is part of the stomach. It is so made that it can grind up the food as teeth would. Some birds swallow bits of shell and gravel, which help the grinding.

The food goes into a bag called a crop. From the crop it goes to the gizzard, where it is ground. Mother birds feed their very young birds with food which has been softened in this way.

When you look at a bird, you will first of all notice the feathers. They are its clothing, and help it in flying. Next to the body grows a soft down. There are patches on the body where only down grows. These spots, bare of feathers, give room for the play or motion of the larger feathers. Such spots do not show, as the over-lapping of the large and small feathers covers them.

The tail and wing feathers are the largest. The quill part of the feather is hollow. You cannot move

[1] Some naturalists deny that birds have the sense of smell to any degree, but experiments with blind birds seem to prove that this sense is well developed.

the hairs on your head. The bird can move its feathers, and turns the large ones flat or sideways, as it changes its flight. The smaller feathers are called coverts. They are laid on one close over the other. They are chiefly for clothes, as the large ones are chiefly for flying.

Many birds have splendid feathers. Have you seen the great train of a peacock? But the peacock is not a bird that flies much. His tail would hinder him in the air. All he can do in flying is to rise to a roof or the limb of a tree. Some other birds have one or two long gay tail plumes which do not hinder their flight.

When the little bird is first hatched it has no feathers. Have you seen the wee chicks, just out of the shell? They are dressed in down. What fluffy balls they are!

Peep into the robin's nest, and see the nearly naked birds. They have for clothes only a few long hairs. Do not touch them. Do not go when the mother bird is there. But peep in each day, and watch how the feathers grow. Or, you can watch feathers grow on your baby canary. They grow very fast.

When first the robins begin to fly, notice that their feathers are not quite like those of the old bird.

The young robin's breast is spotted, not plain red. His feathers lie loosely. He looks puffy. Birds moult or cast their coats. They drop their feathers in hot weather. This gives them a chance to change old broken feathers for new ones. They get warm new coats for winter. They do not drop all the feathers at once. But some feathers go and some come, until the moult is over.

Most birds have some little bags of oil in their skin, on the back part of their bodies. They can press the oil out of these bags with their bills. Have you ever watched birds preening, or dressing themselves? They are spreading this oil over their feathers to keep them soft and clean.

Birds are very lovely creatures. They have graceful, elegant shapes, eyes bright like jewels, and very fine bright colors. They are also very wonderful in their ways. And many of them are very useful.

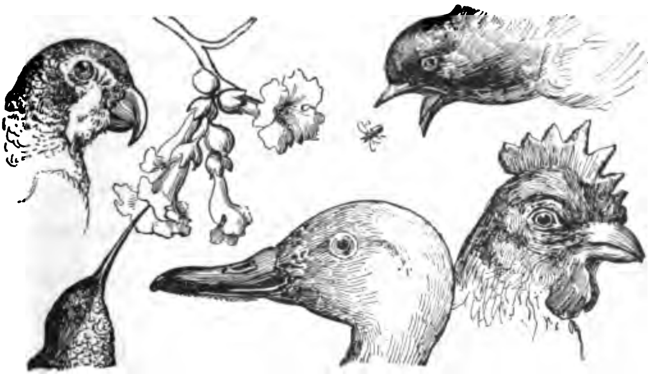
LESSON XXIX.

BEAKS AND CLAWS.

LET us go out and take a walk together. What is this on the ground? It is a bird's foot. You know it by the four toes, three before and one behind; by

the scale-like, rough skin; by the long, sharp nails on the toes.

What is this other thing lying here? That! Why, it is a bird's bill, or beak. You see that it is made in two pieces, of a hard, bony substance. Now from the beak and the bill, can you go on and build up the bird for me? Can you tell me what kind of bird it was; where it lived; what it did; what it ate?



BEAKS.

"No," you say, "of course not." But let us see. Are all beaks alike? Think. "No," you say, "they are not alike." The duck's bill is flat, and soft, and spoon-shaped. The parrot's bill is hard, not wide, but high. The upper part bends over the under. It is curved like a hooked nose.

The hen has a much smaller beak; it is thick, short,

hard, pointed. The two parts join evenly. The swallow has a very short, pointed bill. It can open its mouth very wide. It is a three-cornered bill, — like a triangle in shape. But the humming-bird has a very long, slim bill; almost as slim as a knitting-needle.

Once I saw a kingfisher. He had a thick, strong bill. It was nearly as large as his body. I wondered how he could carry it. In a museum I saw a bird with a bill as wide as my hand, and longer. It looked heavy enough to make the bird fall down.

Now I think you have told me a good many things about beaks. Let us take a little look at them, and see what kinds of feet go with them. How does the duck live? He lives mostly in the water. On land, if he walks, he waddles, but he swims with grace.

He dives down in the water, thrusts his bill into the mud, and feels about for things to eat. There, you see, he needs a wide bill, shaped like a spoon, or shovel. He does not need a very hard bill, as mud is soft. But he needs a bill that can feel the right kind of food, and pick it up, just as your fingers feel things for which you search in a bag.

Now what kind of feet has a duck? It has large feet, with three long front toes, and one short hind toe, rather high up on the foot. What you notice in

the feet is a web, or skin, joining the toes together quite up to the nail.

Have you watched the duck in the water? Have you seen him use these webbed feet for paddles? Now the swimming birds, to which ducks, geese, and swans belong, all have webbed feet. They all have the broad, flat, rather soft bill.

Thus, when you find a wide full-webbed foot, you say, "This bird was built for swimming. It had a light, wide body, shaped much like a boat. Its feet were its paddles. Its wings were not very large. It had very thick feathers, to keep it warm. They were oily to keep it dry. It fed on water plants, seeds, grain, and things that it found in the mud."

Sometimes you will find the beak of a swimming bird telling a different story. It will be a very strong beak, with notches along it. It is a fish-eating swimmer. Its rough bill is to hold fast to the slippery fish.

Then, too, you may find webbed feet which have a new story to tell. You may find a webbed foot, quite small, with a very long leg. The web goes only part way to the toe nail. That bird could not swim. No. He was a wading bird.

His long stilt-like legs held his body above the water,

while he watched for his fish food. The webs in his feet served, not to make him a paddle-foot, but just to keep him from sinking in the soft sand or mud. Or you may find the webs changed to broad flaps on each toe.

Now turn to the hen. Is her beak made for digging in mud, under water? No. Her short, strong beak is for picking up grain or insects from the ground. Now see what feet she has to match this beak. She has walking feet. Her feet are large and strong, with separate toes and strong nails. How does she use her feet? She spends nearly all her time scratching and digging in the ground. She scratches up the earth with her toes. She finds insects, worms, larvæ, and such things, to eat.

Once more look at a beak. Take the swallow's short, wide, widely opening beak. Watch the swallow as he flies. Now up, now down! Now here, now there! He wheels, he makes a dash! He feeds upon the wing. He eats insects. See that short, broad mouth, which opens as wide as his whole head, and shows his big yellow throat. Is it not just the thing for catching insects?

The swallow sweeps after the insect, and into that open throat it goes! What story will this beak tell? The story of a bird made for flying fast and far. The

story of a bird built to wheel and turn quickly. It must have large wings, a very light body. As its head is so wide, it must be flat, or it will be too large.

This bird does not need to walk. Its food is in the air. Its legs and feet will be very small. Its toes will be long, and made for holding or clinging to trees or roofs. Its feathers must be close set; and its tail be well shaped for a rudder.

Suppose some one shows you the foot of an ostrich. It is a huge foot, with two great toes. You will say at once "that is a walking foot." It is not to be carried into the air. These great toes are not for digging, but for walking or running.

Look at the soles of these toes. They are cushioned or padded thick. That bird must live where the soil is soft, and these padded feet will keep him from sinking. Yes, he lived on the desert sand. He is the largest bird in the world. He can run faster than a horse. Such a bird could not be lifted into the air on wings. He has short, stout wings, which he flaps as he runs, and as they have large feathers on them, they catch the air as sails do, and so help him along.

His bill is like a huge hen's bill. He eats melons, grass, and grain.

These are some of the stories told by beaks and feet.

LESSON XXX.

TREE, GROUND, AND WATER BIRDS.

In old times they told fables of birds which had no feet, and lived always on the wing. There are no such birds. All birds have feet, all rest from flying. But the motion of flying is so beautiful and easy, that it is no wonder that birds of strong flight are much upon the wing.

The eagle and hawk families are very swift of

AT THE POND.

flight, and spend most of their time mounting and wheeling. They are keen of sight, and from great heights will see their prey, and swoop down upon it.

The swallow family seems never tired of flying. They feed upon the wing. The tiny humming-birds move their wings so quickly, you cannot see them. They hover with this motion while they drink honey from flowers. They are very seldom seen resting.

Pigeons are among our swiftest birds. Have you noticed how thirsty pigeons are? That is because they are very hot blooded. They need much hot blood to warm up in their lungs the air which they drive through their hollow bones. Thus they make a kind of balloon of their bodies. The pigeon's body helps keep it up in the air.

Many of the birds that live much on the wing build their nests on or in trees. I shall tell you a little of nests in another lesson. Now we will speak of one or two tree-living birds.

The butcher bird, or shrike, is about the size of a robin. It is a pretty bird, gray or brown in color. Its food is living things, as beetles, bees, mice, and young birds. It has a very curious habit. It brings home part of its food, and hangs it on a thorn near its nest.

The butcher bird chooses trees with thorns or sharp twigs, and makes its nest among them. Then on the thorns, all about the nest, it hangs insects and little animals. I saw one of these nests once, about which hung a young bluebird, a beetle, three bees, and a big spider.

I have thought it may hang up little dead animals partly as a trap for big blue-bottle flies. For these flies cluster about the dead bodies, and the shrike, keeping guard near his nest, picks them up at his ease.

A much nicer bird, one which I wish lived in our country, is the bower bird. This bird makes its nest in a tree, but fashions a little arbor for itself, among the grasses. Into its grass palace it brings all the pretty things it can find. Shells, bright stones, bits of cloth, glass, bones, flowers, are all brought to its little play-house. Would you not love a bird which had such pretty ways?

Of all the birds in our own land, none is more splendid than the cardinal bird of the South. He has a crimson beak and plumes. His song is very sweet. He is a brave bird, and very kind and polite to his mate. It is very cruel to kill such a creature for its feathers.

In the North, we have the blue jay, nearly as fine a

bird as the cardinal. He has a jet-black collar, a bright coat of shaded blue, and a white neck-tie. Indeed, he is a fine, gay, saucy, cheerful bird. But he has a very naughty way of breaking up the nests of other birds, and stealing their eggs.

The jay likes to have his home near the water, and when you go near it, he comes out and scolds loudly.

But now we will turn from birds which make their homes in trees, and look a little at birds that live on the ground. You will at once think of the barn-yard fowls, and their many cousins.

Have you seen a barn-yard full of these birds? It is a fine sight. There are the spotted guinea fowls with their fretful cry, and the great peacocks spreading their splendid trains. There are the black, white, yellow, spotted, red, and green-breasted cocks and hens, and there are pheasants which seem to be dressed in rainbows.

Among these fowls the turkey struts, spreading his tail like a wheel, and scraping the tips of his wings on the ground, as he walks high on his toes. Far out in the Western woods, you may see the wild turkey, which is nearly as fine a bird as a pheasant or a peacock.

Turkey hens are very good mothers. They seem very

fond of their little ones, and are always on the watch to guard them. By nature they are shy birds, and like to run away, and hide their nests. One will go off and hide a nest, and seem very proud to come back with a train of fifteen or more little ones.

Grouse, partridges, and quails, are ground-living birds, related to our common fowls. So are the pretty prairie-hens of the West. The quail is a dear little bird. Sometimes in the winter, when the snow is deep, and it cannot find food, it will come to the barn-yard or the door-step, and feed with the fowls. Once, in the woods, I came softly to an opening, and there were about twenty quails feeding on a bed of squaw-berries. They ran about picking up berries and making happy little sounds, like a band of children enjoying a holiday.

One day I was going through a pine-wood path, when a mother quail and ten little ones ran across the roadway. She hid in the brush, and began to call, "Come! Come! Come!" and from the other side of the path, little squeaks replied, "Yes! Yes! Yes!"

Soon three more brown, fluffy balls ran across the road. Then out ran the little brown mother in great distress. Her neck feathers stood out in a collar.

"Come! come! come!" she called. "Wee! wee! wee!" said a little faint voice, and tumbling along the foot path, went one more small bird. "Now she has them all," I thought.

But still, out of the brush, the anxious mother cried, "Come! come!" and at last, dropping into ruts, rolling in the dust, too new and weak even to say, "Wee," hardly able to keep on his legs, went the tiniest little bird! He followed his mother's voice, and slipped in among the brush and pine needles.

When the little brown mother had all her brood, she made a sweet, low, glad note in her hiding place. "O Mrs. Quail!" I cried; "can you count? Can you count fifteen?" She never told me whether she could or not. But she had counted fifteen that time, that was sure.

Now, let us take a peep at the birds which live mostly on the water; you will think first of the great, solemn white swans. Then of the snowy geese and of the parti-colored ducks. What splendid colors ducks have!

If you live by the sea, you will often watch the gulls and gannets with their wide white wings. All these birds build their nests in reeds and grass along the bank, or in ledges of rock in a cliff.

One day I was sitting behind some rocks on a little

island. All at once I heard a hearty laugh. I rose up softly, and looked over the rocks. There on the water sat, all alone, a water-fowl. I hid my head and gave a loud "ha! ha! ha!"

Then the bird threw back his head, and gave a laugh with all its might. It made me think of what my grandfather used to say to the boys, if they were too loud in their mirth for his taste. "Do not laugh like a loon," he would say.

Is it news to you that a bird can laugh? The water-fowl and I laughed at each other for a long time. Then I rose and stood in plain sight. Down he went under the water, and I saw him no more. I wish you would read a lovely poem written by the poet Bryant, about "The Water-fowl."

Once I was out on the sea in a boat. We saw lying on the water the tail of a fish. We rowed near. Well! Here was a sight! A large duck, called an alwife,[1] had tried to swallow a fish. But the fish was too big for her throat. Having got part of it in, she could get the fish neither in nor out. So she and the fish had both choked to death, and were floating around in the water.

A very famous man once said, that he thought a gull

[1] Alwife is probably a short form of "Old Wife." This duck is often called the "Old Squaw" on the Cape Cod coast.

must be the most happy of birds. It can swim, fly, walk, almost equally well. It is at home on earth, water, or air.

I have seen a bird called "The Diver." It goes down under water for its food. It uses its wings under water to swim with, and will stay there a long time. Most ducks will dive, and come up a long way from where they went down.

The water birds all have close, thick plumage. Most of the down which we use, comes from the water birds of the far North. The down not only keeps them warm, but keeps air in its meshes, and helps them to float. It is like a cork jacket for them.

Water birds live chiefly on fish, crabs, and little water animals. But many of them eat seeds and berries of plants growing along the coast. They will readily pick up any kind of food thrown upon the water. Gulls follow ships for days to get the scraps thrown overboard by the sailors.

LESSON XXXI.

ON THE WING.

ROBERT O' LINCOLN.

In the spring and summer, you go to field and garden, and you hear and see many birds. As you walk about the woods, you may see a dozen kinds of birds in

a few minutes. There will go a yellow-bird, looking like a canary. There, all splendid in black and gold, an oriole is busy building his curious nest. There flies from the swamp a red-wing blackbird. A big woodpecker drums on the nearest tree. A bluebird with a russet breast sits singing on the top rail of a fence. Sparrows, swallows, crows, are everywhere.

Out of the grass whirrs up a lark with his brown and yellow coat, and black velvet collar. The thrush sings in a bush. The catbird, in the shade, cheers his mate with a rich, mellow note, and then darts out into the sunshine in his glossy drab dress.

But in late autumn, or in winter, you walk abroad, and where are all the birds? A crow may sit, scolding, on a dead limb. A social robin may flit down to your door. The velvet sparrows may be balls of noise and feathers. But where are the other birds? Are they all dead?

Oh, no! They have flown off to sunny lands, where they will have mild weather, and food in plenty, and green trees. The birds *migrate.* What is it to migrate? It is to go from one place to another a long way off. They migrate as the season changes.

Let us take that pretty bird, the bobolink, as an

example of a bird on his travels. In the winter months he is feasting and singing in the warm West India Islands. There he finds grubs, insects, and seeds in plenty. He grows so fat, that they call him the butter-bird.

About the first of April, he finds Jamaica too hot for him, and flies over to Georgia, or South Carolina. He settles in the rice-fields, and eats so much rice that he is a great trouble to the planters. They call him the rice-bird. But they are soon rid of him. About the middle of May, the rice-bird, with hundreds of his relations, goes up to Virginia and Pennsylvania.

At this time, he eats May-flies, caterpillars, and various insects. But his taste for seeds continues, and he devours the young wheat and barley at a great rate. The farmers name him the reed-bird. Many reed-birds are shot, and sent to market.

In spite of the guns, the bobolink seems now in the gayest hour of his life. He sings with all his might, and his black and white coat, with its touches of yellow, is at its best.

But again he starts northward. He goes up to New York, and New England, and appears in the orchards and wheat-fields, at the end of May, or the first of June. There he is called, from his song, the bobolink.

But Mr. and Mrs. Bobolink must now set themselves to the serious business of making a nest, and rearing a family. They choose a good nest place, and begin to build in a great hurry. Mrs. Bobolink is not so gayly dressed as her mate. She is brown, with a little dull yellow in her plumage.

Mr. Bobolink ends his wildest songs when the little birds come from the shells. Their mouths are always wide open, crying for food. Mr. Bobolink is very busy feeding his children. He flies back and forth all day long, bringing insects to his nursery. The gay concerts are ended.

At this time, too, Mr. Bobolink changes his clothes. He puts on a working suit, with more brown in it. His gay plumes do not come back until the next spring.

After the little ones learn to fly, in August, if it is hot, the whole family may go to Canada, for a trip. But as soon as the cool September mornings come, all the bobolinks think of the South. They gather in great companies, and turn their heads toward the West Indies.

Now and then, they may rest for a few hours, or a warm day or so, but they fly pretty steadily southward. When cold weather has come, we see no more bobolinks. They are all busy eating and singing in the sunny tropic lands.

I wish you would all read, and perhaps learn to recite a charming poem called "Robert o' Lincoln." It was written, by the great poet Bryant, about this little bird of many names, and many homes.

Now from the story of the bobolink, you see the manner of this migration of birds. You see *why* birds migrate. It is to keep where they find the food and the weather which they prefer. Its *cause* is the change of the season. As the season changes the food changes.

Some birds move away because it is growing too hot where they are, and they like cooler places. Again, there are birds which stay near us in the winter, and fly North in the summer, almost to the land of constant snow.

Those birds which breed in the cold polar regions often find a winter home in the Northern States. But some birds which breed in the coldest climates fly to hot countries for their winter of rest and play.

When birds come in the spring, and leave in the fall, they rear their young where they make their summer home. We call them our summer birds.

Our winter birds are those which come to us in the cold weather, do not build nests near us, but fly away when the season grows warm. While they stay near us, they take shelter at night in shrubs or evergreen trees.

What we call birds of passage are birds that stop with us for only a few days, as they are flying long distances, half round the world, perhaps.

Then there are birds, as the robin, sparrow, thrush, which may stay all the year round near one place. In the warm weather they build nests, and rear their young. In cold weather, such birds are often driven near houses and barns to get food.

Crows may stay all winter in one place if food is plenty. If they cannot find enough to eat, they gather in great numbers, and fly to places where they will get more food.

When I was a child, I read that swallows, cuckoos, corn-crakes, and other birds, would lie torpid all winter. The book I read told me that the birds would cluster in great masses, silent, nearly frozen, eating nothing, and in the spring would wake up fresh and gay. That is not at all true. They do not lie torpid. They fly away.

Birds gather in great numbers, with much noise and flurry, to get ready for a trip. Crows, storks, cranes, swallows, and others, fly in great flocks. By the sea-side you may hear a far-off cry and a rush of wings, and looking up, you may see a flock of wild geese, or ducks, on their journey, flying far out over the water.

When a vast flock moves in this way, they seem to have some few wise old birds for guides, in advance, and some for guards on each side of the band. Geese fly in a V-shaped line, for hours at a time. When they need to stop for food, they break the V line and fly in disorder. They seem to search the ground for a feeding place. A cornfield suits them best, and they settle for a feast. If they cannot find a cornfield they will try a swamp.

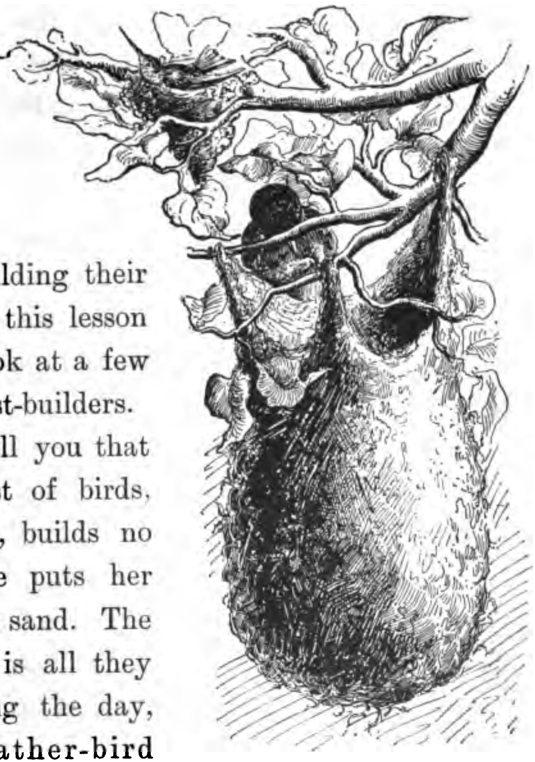
Hawks travel over half the world. The hawk, which summers on the Scotch hills, may go to Egypt for winter, and perch on the pyramids. The stork, which the little Dutch children in Holland feed and love, may go to Africa for Christmas. The birds which you feed in July will be singing in Hayti or Brazil in January.

What is very strange is, that birds will, year after year, come back to the very place and nest that they left. The oriole, catbird, bluebird, jay, titmouse, and others, will each summer return to the same vine or tree, to build a new nest or repair the old one.

They come singing back, and we are glad to see them. But from their songs we get no news of the fair tropic lands where they have been happy amid rich fruits and flowers.

LESSON XXXII.

NEST BUILDING.



ON THE TREE TOP.

I THINK nothing about birds is more interesting than their way of building their nests. In this lesson we will look at a few curious nest-builders.

First, let me tell you that that largest of birds, the ostrich, builds no nest. She puts her eggs in the sand. The sun-heat is all they need during the day, and the father-bird cares for them at night.

A few birds lay their eggs in heaps of dead leaves, and let the leaves keep them warm.

The cuckoo,[1] and the cow-bird[2] lay their eggs in the nest of some other bird. They choose a bird smaller than themselves, and put one egg in its nest. Then they go to another nest, and so on, until their eggs are laid.

A few birds lay their eggs right on the earth, or sand, and make no nest at all. But they sit on the eggs, and brood them. Most birds make nice, careful nests. They seem to take pride in building good homes.

A lady who has carefully studied the ways of birds, says that all birds of a kind do not build equally good nests. For instance, some robins build very strong, neat nests. Others build loose, untidy nests, which will hardly hold the eggs.

This same lady says that birds, by practice, improve in nest building. As a rule, she thinks the old birds, that have built for several years, make better nests than robins building for their first brood. She says she watched a robin, which had a home in her garden. That robin improved in nest building, and built better and better each year.

[1] The cuckoo in England lays in the nests of *other birds. The American cuckoo does not.*

[2] The cow-bird is also called the cow-bunting.

Perhaps no bird builds a more firm, neat, and elegant nest, than that smallest of all,—the humming-bird. This bird does not need a large nest, she is so tiny, and her eggs, usually only two, are like small beans. The nest is made in the shape of a cup. It is built of soft moss, or the downy seeds of plants. These are pressed and moulded until they are almost like felt.

The nest is made quite thick. All over the outside, the bird fastens bits of moss, or lichens. These are stuck on with a kind of glue, from the bird's mouth. This is done, not so much for beauty, as to conceal the nest. When thus pasted over with moss, it looks like a knot or bit of tree branch.

This tiny bird is very shy, and wishes to hide its nest. It is so cunningly built, that even when close by it you are little likely to see it.

The bird does not fly straight to, or from, this nest. That might lead enemies there. Instead, it rises high, straight up into the air, and when up out of sight, takes its direction as it chooses. When it comes back, it pursues a similar plan. From far up in the air, above the nest, it drops straight down, like a little fiery star, into its home.

The goldfinch is another bird which glues mosses on the outside of its nest to hide it. While this is

done rather for use than beauty, I think most birds like to have a pretty home. I have seen birds weave bits of colored wool, or silk, in and out the nest, plainly for the sake of the color, and not for strength.

All the finch family line their nest with down or feathers. The wood-wren, on the contrary, lines its nest always with hair, and never with feathers. She goes far and wide to find soft hairs for this use.

I think an oriole's nest is one of the most beautiful of bird-homes. The mother-oriole makes the nest, and her mate brings her wool, fine root-fibres, hairs and threads, which she uses. If he brings her a bit which she does not like, she throws it away, and seems to think him a bird of very little sense.

If Mrs. Oriole is not suited with her work, as it goes on, she tears it down, and goes to work again. She wants it just right.

The nest is in the shape of a long pocket, and is sewed firmly to some twigs on the end of a branch. It is very curious to see the stitches which are taken in and out, with string, or long horse-hairs. The nest is tied firmly to the tree, and is woven very firmly together. It is lined with downy seeds. The entrance is small and near the top, and the

nest is larger at the bottom, where the young birds will lie.

The tailor-bird sews even better than the oriole. She takes a large leaf, bends the edges against those of a leaf near, and carefully sews them together, with bits of fibre for thread, while her bill is the needle. When this leaf-purse is made, the cunning little mother fills it half full of cotton-like down, from plants, and her home is made. Sometimes she chooses a large leaf, and sews its edges together.

The object of these nests is to have them hung far out, where snakes cannot get at the eggs or young. For you must know that snakes are cruel enemies of birds.

The house-sparrow likes to build her nest under overhanging eaves. If she builds where she has not a roof of that kind, she makes a roof for herself, of straw.

Many birds, as the woodpecker, titmouse, and others, find a hole in a tree, and put in a soft lining. This makes a very nice, safe home.

The golden-crested wren makes a most lovely nest of mosses, woven firmly together with spiders' webs and cobwebs. It is very delicate and pretty.

Just the opposite of this is a magpie's nest. That is

a large platform of coarse twigs, and over it a roof, quite as large, of twigs, while all around it the magpie sets up a thorn fence. You would hardly think a bird could build such a house.

Once I found the nest of the song thrush. It was large, and made of grass, straw, and such things, all firmly plastered with mud. It was nearly as smooth inside as a china bowl. I wondered that this little bird could build such a large, heavy nest.

Many birds which live near the water build their nests among the tall reeds. They will bind three or four reeds together, with the nest hung between them.

No doubt you have often found the neat little round nest of the bluebirds, or yellow-birds, nicely woven of hairs, and made smooth and soft inside. Sometimes their soft, smooth nests are woven of fine, soft fibres. It is wonderful how fine and clean they are, after the little busy bird has made them ready for her home.

Many birds build in clefts of rocks, or under large overhanging stones by the water-side. Their chief thought seems to be, to have the nest safely hidden. Other birds build right on the ground. Have you never found a lark's nest, low among daisies, grass and buttercups?

Last summer I found two nests of the meadow pipit, or pee-wee. They were built of dry grass in a hollow, shaded by some bramble-berry bushes and big dandelions. I had one of these nests drawn for the cover of this Reader. It was a very pretty bower, and the little birds grew up safely.

Most birds build each one alone, but in Africa the weaver-bird lives in colonies. The nests are built like very large wasps' nests. Sometimes one or two hundred birds will build in one place. They make a roof for the nest.

I began by telling you of very little nests. I will end by telling you of a very big nest. I saw the nest of a fishing eagle, in a great pine-tree. The nest was built of large sticks. It was nearly as large as a half barrel. The tree was dead. A tree always dies when an eagle builds in it. This nest was more like a great rough platform than a nest. It had a wall of sticks about it to keep the little eaglets from falling out before their feathers grew.

THE KING OF THE TREE.

LESSON XXXIII.

THE BIRD AT HOME.

You have now seen the bird building a nest, and you have seen the finished nest. Let us take a little look at the bird at home. Let us have a peep at the family life of birds.

The mother-bird lays two, four, six, or more eggs in her nest. Each kind of bird has its own kind of eggs. The wood-pigeon has a pure white egg; the blackbird's egg is a bluish green, with russet spots; the cuckoo's egg is of a yellowish tint

with red and brown marks; the kingfisher's egg is yellow with orange spots; the robin's egg is a lovely greenish blue. Some eggs have purple spots, some are brown with red spots.

Each bird knows its own eggs. Sometimes a lazy cow-bird puts her eggs in the nest of a wren or blue-bird, while that bird is away looking for food. When the bird comes home, she knows at once the strange egg in her nest. She scolds and cries. But, in the end, she takes care of it.

When eggs are put into a nest in this way, it is the strange egg which thrives. The cow-bird hatches before the eggs among which it lies. Then the mother-bird at once begins to feed her adopted child, and her own eggs are left and do not hatch.

The young cuckoo is so big and strong that it pushes its foster brothers and sisters out of the nest, and lives there alone. The good mother-bird, perhaps only a little sparrow, tires herself out bringing insects for the wide-open beak of her big, greedy child.

The mother-bird is very patient all the long days, or weeks, while she must sit brooding her eggs. If you go near her, she may fly off, or she may cower close over her eggs, and look at you in a very timid way. I am sure you will hurry past, and not terrify the dear little thing.

When the mother-bird must go away, to stretch her wings in flight, or to get food, the father-bird takes her place. While she is on the nest, he often brings her something good to eat. He sits on some branch near and sings to her. He watches to see if any snake or squirrel, or other enemy, is coming near. Then he often flies down, and scolds, or pecks at the foe to drive it off.

I am sorry to tell you that the handsome blue jay is very cruel to other birds. He often tears up their nests, breaks their eggs, or kills their little ones, for the mere sake of doing it. The eggs of smaller birds, he carries to his own nestlings for food. I knew a lady who saw a jay bring three small eggs to his nest. He carried them in his bill.

One summer, a pair of woodpeckers built in a tall flag-pole near my house. They had cut out a nice round hole in the pole, and dug a deep place for a nest. Several times each day the father-bird took his turn on the nest, while the mother-bird went off to a swamp to get food.

It was curious to watch the nest-cleaning each night. The birds took up refuse from the nest in their claws, and flew off some distance before they dropped it.

When the little birds came from the shell, the old ones

were very busy, going and coming several times each hour, with food.

It was funny to see them at night-fall. The father-bird took his place, clinging high up on the pole, like a watchman on a tower, to take a final look, and see if all was right. The mother-bird, at the same time, put her handsome head out of the hole, and stretched her neck, as if to take a look from her window before she went to bed.

When the birds were fledged, there was a grand time teaching them to fly. They were taken to a roof near by, where they sprawled about. Then they would be coaxed to make a little flight. The parents flew low and slowly before them. Great was the joy, if one of the little things flew a few yards. The old birds seemed to think that they had never before seen quite such nice flying! Then the father-bird stood proudly before them, to give them a lesson in drumming, that is, in pecking at wood, to break it up, to find grubs or insects hidden in it. He seemed to say, "Look at me!" Then he braced his feet and tail,[1] held his head on one side, and gave a number of swift,

[1] Notice that the woodpecker uses its stiff pointed tail feathers to brace its body when it rises to the full length of its legs to aid it in giving a heavy blow, as it draws down its legs and dashes its beak into the tree with the force of all its weight.

strong blows on my porch roof. He would drum, and then look at the little ones to imitate him.

Then they flew over the way, and the father seemed to say, "Now for another lesson in drumming!" At it he went. But that house had a *tin roof.* He could not make the splinters fly!

He tried again. It was of no use. Then he looked much surprised. He eyed the roof, and tried once more. The little birds looked on.

But the father-bird failed again. Instead of a long, deep roll of sound, there was only a sharp rattle; no chips, no grubs! He seemed much ashamed. His wings and his tail drooped. Away he flew to the pole, and sat there very sad. He seemed to be thinking how much better houses grew when he was young!

The hole of these birds, in the pole, was tinned over after they left. They returned next year, and cut a hole lower down. That was covered with tin in the fall. Next spring, they came back, and cut a hole higher up. They did this for five years.

Finally the pole had to be taken down as dangerous, it was so cut up.

Woodpeckers are not the only good bird parents. You can see how kind and careful mother-birds are, if you watch the hens in the farm-yard. Do you see

them lead their little chicks out? They scratch the earth, and call the chicks to come and pick up food. When a hawk appears, the hen cries out, and spreads her wings wide, to shelter her chicks.

When it rains, or when the little ones are tired, or at night, the hen calls them to rest under her wide, warm wings.

If you watch a pair of robins raising a brood, you will wonder to see how many times in an hour they go and come, bringing food. When the little ones are fledged, notice how they are taught to fly. You may, also, see the father bird giving his little ones a lesson in singing.

When one of the young birds is weaker than the rest, one of the parents will leave the others, and give all the time to teaching and helping that weak one.

A bluebird in my garden, lost, by one trouble and another, all her brood but one. That one the parent birds were teaching to fly. It rested on the gravel walk, while the old birds sat on the fence, and called it.

A boy of three years, seeing the young bird, went up close to look at it. The father bluebird flew close over the child's head scolding. As the child got near the young bird, the old bird flew upon the child's head and pulled his hair with its beak!

The little boy ran screaming back to me. The young bluebird lifted his wings, and flew with his parents into a bush. Was not the father bluebird brave? The child, though only three years old, was many times bigger than the bird.

I told you how the birds cleaned their nests. Birds are neat creatures. You notice that their feathers are bright and clean. Have you seen how much they prune or dress them?

Birds are very fond of a bath. If you set a basin or pan of clean, fresh water, on the grass, among shrubs or trees, you will see many birds going to it to take a bath. They splash the water about in fine style. When the young birds are fledged, they will be brought to your basin to have a wash.

When birds roll or whirl in dust or sand, it is not that they like dirt: they are having a sand bath. The sand flirted in and out among their plumage takes out grease and little insects and dirt Then they shake off all the sand.

LESSON XXXIV.

THE BIRDS OF SONG.

THE woods and the fields would be very dull and silent without the song of the birds. Even the shrill chirp of the sparrow is a pleasant sound to hear. It gives us an idea of happy life.

A JOYFUL SONG.

We will now talk a little about our best song birds. Let us take the catbird first, as that is common in all parts of the country. It is a pretty drab and black bird, about nine inches long.

Tom said to me, "A catbird cannot sing; it gets its name because it squalls like a cat." True, Tom, the bird has that harsh note for you, and to frighten off snakes and other enemies. But you listen to him when he sits in the shade, and sings to himself, or makes his best song for Mrs. Catbird.

Ah, there is a song for you! Mellow and full, and rich as the tones of a mocking-bird! Now he trills, now he whistles, now he imitates the songs of all the sweetest singers of the wood. He can almost outdo the mocking-bird. He sits in his shady covert, and seems to be laughing at all the other singers, as he borrows their music.

First, he breaks out into the oriole's song; then he calls like a jay; next he chatters like a sparrow; then he whistles like a thrush; then he gives you a little warble from the bluebird's music-book. In every song he gives exactly the notes he copies.

A pair of catbirds built in a honeysuckle by my window. I found they were very loving birds. At a cry of pain from Mrs. Catbird or the little ones, the father-bird would come flying back, almost in fits with distress.

He would fly round and round to seek the cause of their trouble. If he found any enemy, which he

could not drive away, he called so loudly and sadly that all the birds near came in haste to help him.

The catbird is one of the bravest of the feathered race. He will fight and drive off a snake. I have seen him defend his home against a jay, a crow, or a squirrel.

A near relative of the catbird is the blackbird. This is a gay and happy creature. All the warm weather it pipes sweetly, as it flies here and there. The red-wing, or colonel blackbird, lives in swamps. The green-breasted blackbird likes a drier home.

Blackbirds are social in their habits. You seldom see one or two alone. If you see one near your home, you will soon see or hear more. They build their nests early in the spring. Young blackbirds are among the first birds fledged in a season.

The nest is large, and often lined with mud. When the mud dries, the nest is like a rude cup. Then a soft lining is put in for a bed. In this nest are laid five eggs of a blue-gray color, dashed with red or brown.

The blackbird is very brave, and will drive a cat or a snake from his home. I have seen him chase a squirrel from his tree.

Pleasant as is the blackbird's note, he cannot rival the thrush. Among all our birds of song, I think the thrush is best known and best loved. This is a small bird, of dusky brown and white, the under part of its body being yellowish white, with black spots. These birds are fond of woody places, and live alone or in pairs. During the middle of the day they are silent.

If you wish to hear the thrush at his best, listen to him in the early morning, or about sundown, when he takes his place on the top twig of the tallest tree he can find. He begins with a clear, sweet sound, like a German flute. Next he trills some notes like the tinkle of a chime of silver bells. Then he pours out a full, rich song, and repeats it several times.

Soon you will hear some other thrush, from another tall tree, answer him. They seem to try which can sing the best. They keep up the concert until the stars come out, and the fireflies flit among the grasses.

The food of the thrush is insects and berries. While he chooses a high place to sing from, he builds low. He finds a laurel or alder bush which is hung with some kind of wild vine, as the Virginia creeper. There he piles up a quantity of withered

beech-leaves. On these he makes a nest of grass, plastered with mud. It is lined with fine root-fibres. In this nest are laid four or five light-blue eggs, without spots or marks.

Often, if you follow the windings of a shaded brook, you may see the thrush playing along above the waters.

When the thrush migrates, he travels by day, and rests at night. When he alights to sleep, he erects his tail-feathers, and ruffles up the feathers on his head. Then he gives a few low calls, hops along the branches, and bends his head down to peep below, and see if all is safe for the night. In fact, from first to last, the song-thrush is a dear and well-behaved little bird.

LESSON XXXV.

THE OTHER PARTNER.

You know I told you that the flowers had gone into business, and taken the birds and insects for their partners. Now these partners are not good friends to each other. In fact, the bird partner is given to eating up the insect partner.

We will now look at some birds that prefer insects to any other food. But these, like all birds, will change their diet and eat almost anything if very hungry.

Our first bird shall be the "nuthatch." It has been given this name because people think it can crack nuts. No doubt it can crack beech and hazel nuts, and chestnuts. Its object is not to get the meat of the nut, but the grubs that lie in it.

The nuthatch is of a light bluish-gray color, with some white and black in its feathers. It is not much larger than a thrush.

Early in April, the nuthatch finds a hole in a tree, or in a fence rail or an old roof. There he makes a nest by piling up dead leaves and any soft wool or hairs he can find.

In this nest are laid five white eggs, with brown spots on one end. While the mother bird sits on these eggs, the mate spends all his time near her. If any danger comes, he flies to the nest. He hunts for nice fat grubs and worms, and takes them to the sitting bird to eat.

He searches for insects and larvæ, and little can escape his big bright eyes. When he takes something to his mate, he gives a soft, low, glad chirp. He never passes the door of the nest-hole with-

out putting in his head, to make a few cheerful remarks. He seems to be telling the news.

When the mother-bird flies out, to have a chance to find food for herself, her mate keeps calling her, as if to say, "Are you quite safe?" "Are you there?" And she replies with a little note of joy.

The nuthatch finds most of his food under the bark of trees. He flies round and round the tree and strips off pieces of bark. Hidden there, he finds worms, spiders, caterpillars, eggs and larvæ of insects. He seems very curious, and pries into every crack and hole.

The nuthatch seldom migrates. If food is scarce, he will fly to the barns, and even pick up seeds with the fowls. But he does not like that food. He prefers insects.

Another bird that feeds chiefly on insects, is, in many respects, the loveliest and dearest of birds. Can you not guess that I mean the bluebird? This bird, with its blue back and wings, and ruddy breast is the first to tell us of the return of spring.

On warm days in February, or early March, we see him flitting above the last melting breaths of snow, or sitting on the top rail of the fence. If a few cold snowy days come, he vanishes. But back he flies with his mate, and they skim low over the

ground to pick up the first beetles, worms, and spiders that venture out.

For a few days the two are very busy eating insects. If Mr. Bluebird finds a very nice, fat bug, he does not keep it for himself, but flies with it to his mate. He gives a glad cry, spreads his wings wide, and drops it into her mouth.

But soon the pair set about cleaning and rebuilding last year's nest. If there is a box on a tree in your garden or orchard, or a hole in a branch, they will build there year after year.

While the bluebirds are busy setting their house in order, Mrs. House-Wren gets back from her winter trip. She peeps in, and seems much vexed that such a nice house was let before she arrived. As soon as the bluebirds go off, for some more grass, or hairs, Mrs. Wren steps in, and pulls a few twigs out of the new nest. She does this to show her feelings. But she hurries away, before the blue owners return.

Mrs. Bluebird puts five or six pale blue eggs in her nest. She raises two, or even three, broods in a summer. While she is sitting on the second eggs, the father bird watches over the young of the first brood. He feeds them, and takes great care of them, and lets them perch by him at night.

Now and then, in the autumn, you will see a pair of old bluebirds with ten or twelve young ones, of their various broods. Then they may be feeding on gum-tree or smilax berries. But spiders and beetles are their chosen food.

The note of the bluebird is a soft, sweet warble. He loves sunshine and springtime. In the fall his note becomes sad and low, as if he mourns because winter is coming.

When the cold winds, and frosts, and bare trees, make the country desolate, the bluebird migrates. He goes to the Southern States, the West Indies, and Mexico. We are all glad to welcome him back. He is the prophet of fine weather. The farmers like him because he eats so many harmful insects.

Of all the insect-eating birds, none is more famous than the flycatcher, or kingbird. In some places he is called the field-martin, and the tyrant. The name flycatcher comes from his food. He catches living, full-grown insects, such as flies, gnats, wasps, and some bees. I am sorry that he is accused of picking up bees.

The name king, or tyrant, bird comes to this brisk little fellow from his manners. He is very strong, very swift on the wing, and very bold. He is fond of his brood and mate, and bold in their

defence. He watches to drive off birds which might harm them.

The big blue jay dares not rob a kingbird's nest. The kingbird will chase a jay, a crow, even an eagle, or a hawk. His bill is sharp and strong, and as he flies under or over his enemy, he darts at him, and drives his bill into him with a peck.

He is so fierce only when he has a young brood to defend. At other times he is quiet enough. When his young brood is in the nest, he feels so proud that he seems to think himself the lord of all birds.

The purple martin can fly faster than the kingbird and likes to tease him. It is also very funny to see a big woodpecker and a kingbird having a conflict on a fence rail. The woodpecker whirls round and round like a boy turning springs over a bar. The kingbird flies from side to side and tries to get a peck at him but cannot.

The kingbird is not a singer. He is a silent, dark bird. His plumes are brown, black, and white. On his head he has a crest, or crown of raised feathers. He seems very particular about his food. It is not every insect that he will eat.

Many farmers, who have watched him carefully, say that he does not pick up worker-bees, but takes

only the drones. He also eats many gad-flies that trouble and bite the horses. He devours hundreds of insects and worms which eat fruit, cucumbers, and pumpkins.

In fact, even if the kingbird does eat a few bees, he more than pays for that damage by the good he does in destroying harmful insects. When a farmer shoots a kingbird he shoots one of his best friends. Besides all this, as we are not quite sure that the kingbird does eat worker-bees, I think we should give him the benefit of the doubt and let him live.

LESSON XXXVI.

A BRIGADE OF BIRDS.

In some of the lessons in these Nature Readers, you have been told of crabs that are street-cleaners of the sea. You have also been told of insects that are cleaners of the air. I shall now tell you of some birds that are cleaners of fields and woods.

This lesson will be about a brigade of birds that do street-cleaning work. I shall head the list with the crow. You have seen that big, black bird

standing all alone on a dead tree, looking the country over. You have seen him following the farmer's rake and plough in the spring.

You have seen hundreds of crows come together in the fall, to discuss their migration. You know their loud, harsh note. You have seen them in their sleek, black coats, stepping over the snow in winter time. You know in cold weather they become very tame, and draw near the houses for food.

One day I heard a loud cawing of crows, and looking out saw about twenty of them flying in a long, low line over some bushes, in a field. Every now and then they stooped to the earth. I watched. They were chasing a cat. The cat hid in the bushes. He was trying to escape from the crows.

They flew over the bushes and scolded. Then, as he ran from one shelter to the next, they stooped and pecked him. They chased the poor cat all across a big field. I think he was very glad when he got under a barn. I suppose the crows saw that he was watching them, and so they drove him away.

When a number of crows are in a field, they keep one crow on a high place, to warn them if danger is near. They seem to be very wise birds. They know a man with a gun, as far as they can see him.

Crows do some harm by pulling up and eating the planted corn and sown grain. But they are of use, as they eat many worms and insects which destroy crops. You often see crows following a farmer as he ploughs. They are after the grubs and worms in the new furrow.

Crows eat lizards, mice, toads, and moles. They also feed on any dead and decaying flesh which they can find. A company of crows will pluck off all the flesh from a decaying animal, and leave the bones white and clean.

The crow is about as large as a large pigeon. It is jet black, and not handsome. Like all flesh-eating birds it has a large strong beak and large strong feet. These are for tearing their prey.

As crows kill young chicks and pull up grain, farmers dislike them. Have you not seen images placed in fields, to scare the crows from the crops?

Crows are very noisy except when they are raising a young brood. Then they are quiet. They do not wish the nest to be found. The nest is large and made of moss, sticks, leaves, bark, and hairs. It is built in a high tree. In it are four pale-green eggs, with olive spots.

Mr. Crow helps brood the eggs. He keeps a sharp lookout for danger for half a mile about his nest.

He hunts for food and brings some to Mrs. Crow as she sits on her eggs.

Toward the end of summer, the young crows can fly well. Then many families of crows go to pass the night together in some place that they have chosen. I used to like to watch great flocks of crows going at sunset towards their roost. In the morning they returned.

Crows like to live near the sea. They catch small fish. They carry shell-fish high up in the air in their claws, and let them drop on a rock. The fall breaks the shells and the crows fly down and pick out what is inside.

The jackdaw and the magpie are cousins of the crow. They also eat flesh. They are larger than the crow, and have some white in their plumage. They can both be taught to speak.

The jackdaw likes to carry off and hide things. I knew one that lived in a garden, where some swans were kept on a pond. The naughty jackdaw would go and carry off all the swans' food and hide it.

If we walked near his hiding-places, he would run after us and peck our shoes. The gardener had to put a wire fence all around the pond, and clip the daw's wings so that he could not fly over the fence to rob the swans.

A much larger bird than these is the turkey buzzard. He is about the size of a small turkey, and is of a faded black color. His head and neck are bare of feathers. The skin of the head and neck is reddish and wrinkled. It has a little black hair and down on it. The bill is very large and hooked. The feet are also very large.

This is the least handsome of all our birds, and no one likes it. The reason of the dislike is, the bad odor the bird has. This odor comes from the decayed animal food which the buzzard eats. But it is this very habit of eating spoiled food which makes the poor bird so useful to us.

The buzzard has a swift flight and a keen eye. It can see its dead food far off. When you see three or four buzzards wheeling in the air, you may be sure that some dead animal lies on the ground below them.

Any one who knows how the carcass of a sheep, cow, dog, or cat will infect the air for miles about, will feel glad that the buzzards like to eat such things. The buzzards strip off all the ill-smelling flesh, and leave only clean white bones.

The buzzard is a very mild, quiet bird. It never fights, and never eats any live prey. It tears up no corn, and carries off no little chicks. In most States there is a law against killing a buzzard.

The buzzard makes no nest. It finds a hollow stump, or a broken tree, and lays two or four eggs on the decayed wood. The eggs are about the size of goose eggs. They have brown spots on them. The young ones are covered with down like young goslings. Buzzards are American birds.

The large carrion crow, or black vulture, is a bird much like the buzzard in its habits. But it lives farther south, is seen in greater numbers, and is not so shy. They are often tamed, and kept near the markets to clean up offal. They like to sit on the chimney tops to enjoy the warm air that rises.

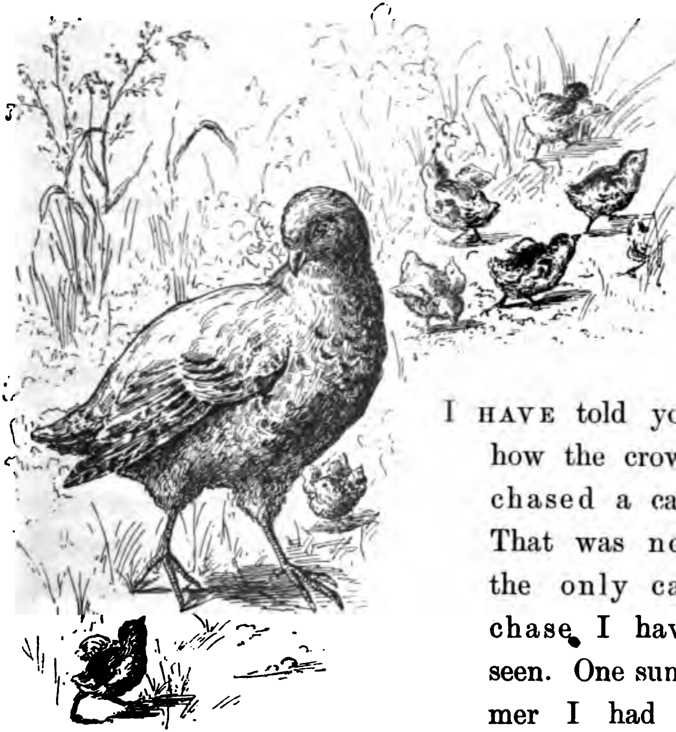
Dogs and black vultures will feed together on a carcass. But if the dogs crowd the birds too much, the vultures will hiss at them. These black vultures do good service by eating up alligators' eggs.

Another of our brigade of flesh-eating birds is the raven. The raven is a handsomer bird than the others. His glossy black feathers have blue and green tints on them. Ravens are often found in sea-side cliffs and trees. They feed on dead fish.

The raven is noted as one of the most long-lived of birds. They are said to live a hundred years. They are found in nearly all climates and countries. While they eat all kinds of dead animal matter, they will also carry off young ducks and chickens.

LESSON XXXVII.

THE BIRDS IN THE WOODS.



UNDER THE TREES.

I HAVE told you how the crows chased a cat. That was not the only cat chase I have seen. One summer I had a house near a wood. Through the wood ran a brook, and near it was a marshy place. This is just such a spot as birds love.

In that township no one was allowed to shoot birds, so birds of many kinds were plenty.

One day, as I stood on my porch, I heard a queer noise. Then around the corner of the house rushed a cat. After him, screaming, and flying low, came about twenty birds. They were headed by a blue jay. The jay flew down on the cat, and gave him a sharp peck. He pulled out some of the cat's fur.

Among these birds I saw the robin, oriole, wren, cat-bird, yellow-bird, yellow-hammer, blackbird, and several sparrows. They may have their little quarrels among themselves, but they all make common cause when the cat prowls in the woods to kill them.

Once, when I lived in the southwest, I had many forest trees on my lawn. In these trees lived such birds as I have just named, also the peewee, the tit-mouse, and the bluebird. I had a tame squirrel that went up the trees and frightened the birds.

After that they kept a sentinel always on a limb. If the squirrel left the grass for any tree, the alarm was sounded at once. Then all the birds near came in haste, and attacked the squirrel. They pecked and screamed at him, until he was glad to keep out of the trees. Soon he did not dare to touch a tree trunk.

Among the wood birds the woodpecker is one of my favorites. He is a very fine fellow. There are many kinds of woodpeckers. We have the red-headed, the yellow-breasted, the gold-winged, the hairy, the downy, and others.

They are very intelligent, diligent, and merry birds. They make their nests in holes in trees. It is wonderful how they know where to find a decayed spot in a tree that looks quite sound. The woodpecker will eat fruit and grain, but prefers insects. He, no doubt, saves many forest trees by eating up grubs and worms, which would destroy them.

The woodpecker is a noisy bird. He is full of chatter to his mate. He talks to himself constantly when alone. His "drum" can be heard over all the wood.

It is a fine sight to see him on a brown tree trunk. His plumage, black, white, green, scarlet, gold, can be seen from far. He whirls about, looking for grubs. He holds fast with his strong claws, and gives blow after blow with his great bill upon the tree.

When he tears off a large piece of bark, and lays bare a fine fat grub, he throws back his head, and laughs with joy. He laughs almost as well as the loon, of which I told you.

It seems a great shame to kill such a handsome and happy bird. He really does very little harm, and much good. Now and then, he carries off a pear or an apple to eat, but he saves the lives of many trees.

Among the joyous birds of the wood, let us now take a look at the bird which is every one's friend. There is a bird that every one loves, and no one says an ill word of. Can you guess that this is the cheerful robin? He is our friend the year round. His red vest shines against the summer green and the winter snow.

The robin is a large bird, with black and brown head and wings; most of the rest of the body is of a dull, yellowish red. Of all our birds this is the least shy. He is brave and merry, and goes and comes as he pleases. Scarcely a month of the year passes without bringing the robin.

Robins seem equally happy in wood, field, garden or orchard. If they cannot find insects to eat, they will take fruit, berries, crumbs or seeds. If food grows scarce, they hop down to the door, and feed with the chicks, or expect a fine breakfast thrown out to them alone.

Some people think that robins eat fruit rather as drink than as food. They take the fruit because they

are thirsty. It is said that if a pail of water is set near the fruit trees, the birds will drink from that and not rob the trees. You might try it sometime, and find out if this is so.

The robin builds a large nest of straw and fibres. She plasters it with mud, and lines it with fine grass. She will come back to the same nest year after year. In this nest she lays five eggs of a bright blue-green color.

If the robin has taken a winter trip, he comes back early in March to settle in the Northern and Middle States. Sometimes he does not leave his home in winter. Sometimes he goes and comes a number of times, as if he wanted to keep an eye on his house.

In March and April you see these birds in pairs. They will be running about the short grass, hunting for leaves, or sitting in the bare branches, trying a song. The robin cannot sing so well as the thrush; but he is fond of singing, and his note is merry if not rich.

As soon as day breaks, you will hear the robin chorus. All day long robin rests himself from work by singing. In the wood he quarrels with no other bird, and no other bird quarrels with him. The robin can be seen in the autumn, feasting wherever

there are poke or elder berries. He is a long-lived bird, and, if he meets with no accident, may live fifteen or eighteen years.

A larger and gayer bird than the robin, and living often in the same wood, is the blue jay. I have told you of some of this fine fellow's naughty ways. Did you ever see him? Did you notice his big black bill, his great keen eyes, his saucy crest, standing up like a helmet, his fine blue back, his blue and white wings and tail, with black bars? Oh, he is a kingly bird! And he knows it!

Of all our birds none is more pert and saucy than the jay. His voice is loud, and he likes to hear it. He is the trumpeter in the bird band. He has a varied note, and can mock the songs of other birds. He chatters like a duck; he screams like an angry catbird; he whistles; he laughs; and then he goes into the shade, and talks to his mate in a soft musical tone.

He seems to be vain of his fine clothes. Sometimes he stands on a branch, and makes such wild noises that all the birds in the wood fly to see what is the matter. Then, when he has a number of birds to gaze at him, he bows, nods, jerks, flirts, whirls, and makes all manner of the queerest motions. He seems to be giving some sort of a show.

One of the jay's family names is "the gabbler." It is said that, like the crow and some other birds, he is a weather prophet, and most noisy before a rain-storm.

The jay will eat almost any kind of food. He eats the eggs and young of smaller birds. He eats chestnuts, acorns, corn, cherries, insects. When very hungry, he will take a small potato, or go to the barn for corn and oats.

Of all the bird partners of the plant in seed-carrying, the jay is chief. One man, who studied this bird very carefully, said, "The jays are able, in a few years' time, to replant all our waste lands." No bird is more useful in carrying about nuts and hard seeds.

The jay is especially the bird of North America. He is not a very great traveller. Usually each pair lives alone, and then with their young brood. But sometimes in the autumn forty or fifty will go together to look for acorns.

The jay likes to build in a quiet wood, near a stream. He builds a large nest in a tree, and watches over it, but does not often go very near it. The mother jay lays five eggs of olive color, with brown spots. When the young birds come from the shell, both parents take great care of them.

One day I saw in a wood five new-fledged jays, sitting on a branch. They were not at all afraid of me. But the old birds came near, and seemed in such distress at seeing me, that I went away. A few weeks after I saw the whole family, carrying stores of chestnuts, acorns, and seeds to hide, for they are given to laying up a hoard of food.

The jay is the great enemy of the owl. As soon as he finds an owl hidden in the shade, he calls all the other birds to the battle. Then, headed by the jay, they scold and scream, and fly at the owl, until they drive him off.

He quarrels also with the small sparrow-hawk. But in that quarrel poor Mr. Jay sometimes is killed. When he fights the hawk, he calls other jays to his help. If one of them is killed by the hawk, they all give loud, wild cries. Then they fly off and, hidden in the wood, complain of their disaster.

LESSON XXXVIII.

THE BIRDS IN THE HOUSE.

As so many of you have cage birds, I think you will like to hear a little about the kinds of birds that most often live in cages. I will tell you of only

the two most common kinds of pet birds, — the canary and the parrot.

As the parrot is the larger bird and of more ancient fame, we will speak of him first. Parrots have been favorite cage birds for many hundred years. They are notable for size, splendor of plumage, docility, long life, and power of learning to speak.

Like the woodpecker, the parrot belongs to the division of climbing birds. The feet of climbing birds have two toes turned forward, and two turned backward.

The parrot family is a group of large and splendid birds. You will know even the smaller members of it by their bills. The bills are high and thick, and have the upper part much curved and longer than the under part. This bill is useful in aiding the birds in climbing, and in holding fast to the branches of trees. It is just the right kind of bill for eating fruit, which forms the chief food of the parrot in its wild state.

The tongue of the parrot is short, thick, and fleshy. The wings and tail are long. The plumage is gay.

To the parrot family belong the parrakeets, cockatoos, macaws, and lories. These are all birds of hot countries.

Nothing can exceed the splendor of the plumage of

these birds. Red, lemon, green, scarlet, blue, white, and a mixture of these colors, will be found upon them. Many of them have brilliant crests, and many of them long gay tail feathers.

The head and bill of the parrot are large. While their bill tells us what kind of food they live on, and their feet show that they can climb, their long strong wings show that they are birds of flight.

Parrots are social birds. They live in large flocks. They make their nests in hollow trees, as woodpeckers do. In their native homes they are much like woodpeckers in some of their ways. But they eat fruit, not insects.

The natural voice of the parrot is a loud, harsh call. Parrots can learn to speak only when they are carefully taught. Not every kind of parrot can learn even when taught. The common short-tailed, red and green parrot makes the best talker. Some of them are very amusing.

Parrots are usually of a kind, gentle disposition, easily tamed, and learn to live very happily in a cage. When captive they eat sugar, crackers, and almost any little dainty that is offered to them. They are fond of water, and bathe often.

The very long-tailed parrots called macaws, and parrakeets, are birds of Central and Southern America.

In India there are also very long-tailed parrots. In old times they were sent as presents to kings and queens. The parrakeets of Asia and Africa are called ring parrakeets, because each one has a collar of bright feathers about the neck. The two parrots called "the gray," and "the festive," or "jolly" parrot, are the most common as pets, are most amusing, and learn many words and tricks.

What are called "love birds" are very small and beautiful parrots, from North Africa. They are as small as bluebirds. They are the smallest of their race, and rather rare.

The cockatoos are kept in cages, not for their speech, as they do not learn to talk, but for their great beauty. You will know them by their high crests. They have their name from their note, or call. They are natives of tropic islands. Most of them have light-colored feathers, pink, lemon or white, with markings of brighter tints.

If you live where you can visit a large bird-store, you will do well to go to see some of these birds.

Let us now turn to that other house bird, and common pet, the canary.

This little bird has its name from some islands on the coast of Africa, which are its native home. It is

about three hundred years since these birds began to be reared and sold for cage birds.

Canaries are very small birds, of a delicate yellow color, graceful shape, bright and lively ways, and sweet song.

In their native woods they have not the clear yellow color which they now wear. They are of an olive green with spots of black and yellow. The yellow color has become common to the cage birds.

Canaries are intelligent, affectionate little birds. They can be taught to whistle tunes, if you train them with care and patience. If given plenty of water, clean cages, plenty of light, and good fresh seed, they will be healthy and live a long time.

You should give them a lump of sugar for a treat, some chick-weed for fresh food, a bit of cuttle-fish bone to sharpen their beak upon. You must also be careful to keep them out of a draught.

These birds of hot lands, reared in cages, would die if we let them fly out of the cage. So, if we treat them well, it does not seem cruel to keep them in their little wire palaces.

For my part, I prefer to see birds flying, feeding, and singing in the woods and fields, which are their natural home.

LESSON XXXIX.

THE LOST BIRDS.

HIDDEN in the earth, in peat swamps, or in rocks, we find the bones of birds of various kinds that lived long ago, and are now lost. Some of these lost birds were on the earth before men and beasts were. Others have been well known until a recent time. I shall tell you of a few that have lived until lately.

First I shall mention the great auk. This was a large handsome bird, which lived along the shores and islands of northern seas. As auks were good to eat, large numbers of them were killed.

There should have been a law to protect them while they were raising their young. As there was no such law, the birds were killed at any time, and their eggs and young were taken. Thus year by year they perished, until none are left.

The auk was a very large bird, with black and white feathers. It had very short legs, broad, webbed feet, and very small wings. When sitting at rest on a rock, it held itself straight up and was nearly a yard high.

It was a wonderful swimmer and diver, but could not walk much, and did not fly except from rock to rock. Its bill was very large and strong. The auk was a fish-catcher and eater.

As to these very big bills, such as you see on the toucan and hornbill in museums, where the bill is nearly as large as all the rest of the bird, let me tell you a secret. Do not they look very heavy? Do you not wonder how the bird can carry them, or fly with them?

Here is the truth. The horny hard part is very thin, not thicker than a sheet of paper. Then all the inside of the bill is built up in cells, something like a fine honey-comb, and these cells are full of air! So instead of being heavy, these huge bills are very light.

The bill of the auk was large, but not nearly so large as that of the hornbill or toucan.

A neighbor of the auk was the Labrador duck. This bird often built its nest close by where the auk laid its great, bright-colored eggs, near the water's edge. The Labrador duck and the auk swam in the same waters, and were both very gentle birds.

This duck, like the auk, is now lost. The last one seems to have been killed a few years ago. The Labrador duck was a very beautiful bird. People

wanted its eggs, flesh and feathers, and did not spare the old birds to raise their broods.

This makes me think of the fable of the greedy man, who killed the goose that laid golden eggs. Then he had neither goose nor eggs. I think it served him right.

Chief among lost birds is the famous dodo. This dodo was an immense pigeon. It was a helpless, quiet, kind, clumsy bird. It was too heavy and too short of wing to fly. It had no weapon of defence; no sharp, strong bill; no tearing claws.

Such a bird was easily caught and torn to pieces by dogs or cats. When these animals were taken to the island of Mauritius, where the dodo lived, they were allowed to run wild in the woods. They soon became more like wolves and panthers than decent dogs and cats.

The dodo had never before seen any wild animals larger than rats or squirrels. The dodos lived in peace and friendship with other birds and small wild beasts. When ships began to visit the islands where the poor dodos lived, men, dogs, and cats soon put an end to the gentle birds.

Lost, with the auk and dodo, we may count two kinds of beautiful parrots, and a starling with a splendid crest, like an unfurled fan; also a tall, hand-

some bird, called a rail, has been hunted out of existence. But some other rails are still plentiful.

The last bird to disappear has been the great vulture of the Alps. This was a big bird indeed. It was two yards wide across the outspread wings. It lived on the high peaks of the Alps.

This bird had a large hooked beak and large strong claws. You know that eagles and vultures are flesh eaters. This big vulture did not confine its diet to dead flesh. It would pick up and carry off a little lamb. It has been known, also, to carry off a baby child.

So, as this was a cruel and dangerous bird, I am glad it has gone from the earth.

The garefowl, often called a penguin, is another lost bird. It was a great bird, living on the coast. It had such small wings that it could not fly. Thus you see it could not get away from dogs and wild animals, except when it could take to the water.

When men joined in the hunt, the garefowl soon perished. Is it not right, then, to kill birds for food? Yes. But they should never be killed until the season is over when they are laying eggs and raising the young brood. If old birds are killed before the young ones are reared, you can see that the birds must soon die out.

Then, too, while birds may be killed for food, it is not right to kill them for the mere pleasure of killing. It is wrong to find a pleasure in taking away life. You should never waste the life of beast, bird, insect, or plant.

I have seen people nearly destroy a variety of rare wild flower, by tearing up masses of the plant before seeds had time to form. The people took much that they did not need and soon threw away. Then only few and small plants were left for seed.

We should remember that as we are not the first people on the earth, so we shall not be the last, and we should not rob the future of things that are pleasing to us. We should all try to make the earth richer and better, not poorer, for our having been in it.

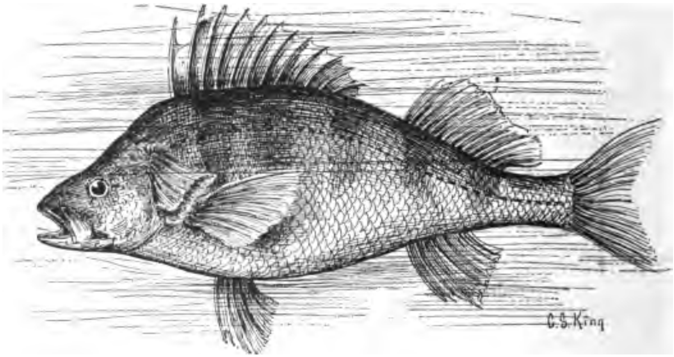
LESSON XL.

THE FIN FAMILY.

I REMEMBER when I thought that no living thing was of so little interest as a fish. I used to wonder how it was that the great Agassiz began his studies in Nature with fish. I did not think that fish were even pretty.

I suppose that was because I knew nothing about them. When we are quite ignorant of a subject, we are apt to think it has no interest.

One reason why, in these Nature Readers, I am telling you something of many things is, that by knowing a little of these subjects, your interest in them may be aroused. Then you will try to learn more; and the more you know, the more you will enjoy.



IN THE COOL DEPTHS.

Once, if you had asked me, "What is a fish?" I should have said, "Oh, a fish is a long thing, with scales and fins; and it lives in the water!" How many of you can tell me anything more than that? Perhaps you will add that a fish is good to eat.

Well, one day I went into a house where there was a great glass tank. It was like a glass room full

of water. As I stood looking in through the glass side of this tank, I saw, gliding through the water, a large, lovely creature, in silver and rose color. It had big black eyes, set in a golden ring.

This creature seemed to move without the least effort. It made no sound. It slid by me like the figures in a beautiful dream. It rose. It turned. It sank,—and all without seeming to exert itself in the least. I saw no effort at motion, but now and then a tremor of a forked tail, and now and then the gentle wave to and fro of a pair of gleaming, thin, silken things, like fans, half unfurled.

This, then, was a fish at home! Here was a fish living in the water, and doing as it pleased. The clear water added to its beauty. It shone like a gem. Other creatures, as beautiful, but different, lived with it. They crossed and recrossed each other's course. They left no track. They had no path. They moved on, far more easily than a bird moves in the air, or a man on the land.

From that day I loved the fin family. Let us look at this family.

I told you that a bird is built on the plan of a boat to sail in the air. The fish, also, is built on the boat plan. He is a boat to move not *on*, but *in*, the water.

Perhaps this is not a fair way of speaking; for birds and fish were made long before men. And no doubt men built their boats on the plan of the water-birds and the fish.

The fishes vary much in shape and size. We will speak now of the ordinary fish type. We will take a model or pattern fish, such as the perch or the mackerel.

The head is sharp and wedge-shaped. It serves as the prow of the boat, to divide the water. The body is long, narrow, smooth. It has scales lapping over each other, and are all turned from the head toward the tail.

The tail is like the rudder of a boat, to direct its course. It serves also as the paddle, or propeller, to drive it through the water. There is a long slim fin on each side, just below and behind the head. These serve as balances, and, also, sometimes as oars.

There is a long fin, sometimes there are two fins, on the ridge of the back. There are also two fins on the lower line of the body. These steady the fish in the water. They help to keep it, as you would say, "right side up." There are two more fins under the body, near the tail. What you call the tail is really a fin. The true tail is the narrow end of the body, just above this final fin.

Let us look at the head. Just on the front is the mouth. It has plenty of teeth. I shall tell you of these teeth in another lesson, when I tell you about the scales. Just above and behind the mouth are the eyes, one on each side of the head. They never have any eyelids.

Below and back of the eyes are the gills and gill-covers. Gills are wonderful things, which serve the fish for lungs. These gills can take, or sift, out of the water, the oxygen of the air that is mixed with the water.

The fish takes the water in at his mouth. Then, by a motion like swallowing, he drives it out through the gills; and the gills sift out the oxygen, as the water passes through them. Fish need that part of air called oxygen to purify their blood; just as you need it.

If fish are kept in a vase where the water is not renewed, they soon die for lack of oxygen. If they are put into water which has been boiled, they die, because boiling has driven out the oxygen.

Perhaps you have been told that fish breathe water, as you breathe air. That is not true. Fish breathe air, but the air must be sifted through their fine gills. When you pull a fish out of water, he pants and struggles and cannot get his breath. His

fine gills stick together, and cannot do their work. So the fish chokes to death. His panting action is an effort to get air.

Fish with the thinnest and finest gills, as herring, choke very soon. A carp, perch, or other fish that have gill-covers that will hold moisture, and gills that will keep wet a long time, will live one, two, or more hours in the air.

Fish have inside the body an air-bladder, or bag of air. This may help them in breathing, but its chief use is to keep them up in the water. The bladder lies under the backbone. This backbone runs from the head to the tail of the fish. It is made of little pieces like cups. Each piece has two or more long spines, like ribs, on each side of it.

The bony frame of a fish is very curious. You should try to have a fish skeleton to look at. There are little bones that extend from each division of the fins. You will see that the skeleton looks somewhat like the ribs or frame of a boat before the planks are put on.

The bright color and gleam of the fish is in the scales. I will tell you of these later. The scales are like a rich, flexible suit of armor.

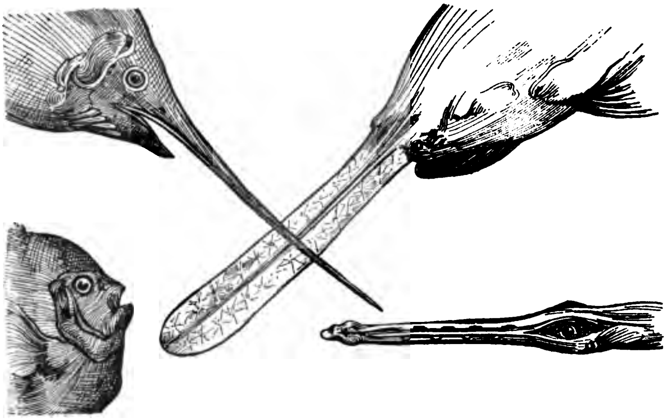
Fish have cold blood, not warm like yours. They have very keen sight and smell. Probably they have

good hearing, and but little sense of touch or taste. They have small brains, and not very much intelligence.

LESSON XLI.

OUTSIDE AND INSIDE.

IF I ask you what is the largest of all fish, you will say "a whale." But let me tell you that a whale is not a fish. A whale is an animal that spends



QUEER NOSES.

all its time *in* the water, but cannot live constantly *under* water. If cast ashore it will die, because it has no means of getting back into the water, and no food on the land.

But whales have no gills, and they breathe air as you do. They are so made that they can, with safety, remain under water for a much longer time than you can. If a whale is kept under water too long, he drowns. So we must leave whales, nar-whales, and porpoises out of our account of fishes.

Among real fish you will find some of great size. Sturgeon have been caught which weighed five hundred pounds. They were twelve or fourteen feet long. Yet this size seems small when we compare it with that of the great shark which has been found thirty feet long.

A queer contrast with such a vast creature is the little minnow, which you catch in ponds and brooks. It is not much over an inch long. Little English boys in their first fishing trips go for sticklebacks, a fish from one to two inches long. I shall tell you in another lesson of this amusing little fish.

The fish usually chosen as a type, or model, of the fish race, is a perch. We find fishes[1] differing from the general perch pattern as much as flower differs from flower.

The perch is a wedge-shaped fish, and is a beautiful creature. Let us see how others of the fin family

[1] Both *fish* and *fishes* are correct plural forms, and both are used to accustom the child to both words.

differ from the pattern I described to you in the last lesson.

Instead of having a clear, round, full, bright eye like that of a perch, some fishes, which live in mud, or in very deep water, have tiny eyes, like dots. Some fishes which live in streams in dark caves have really no eyes.

The perch is covered with scales of a rich green-brown and a golden white. Some fish, as the eel and sword-fish, have no scales. A shark has no true scales, but his skin has hardened into little bony points. Some other fish, instead of scales, have large bony plates. The heads and the fins seldom have any scales upon them.

If you could see a large collection of fish, you would wonder at the variety of shape. You would see the "perch pattern" changed in almost every possible way. Perhaps the first odd-shaped family to notice would be the rays.

The fish of this family are flat. Their bodies are shaped much like a flat triangle, finished with a long slim tail. The ray's mouth is on the under side of his body. The most common members of the ray family are the skates. They are of a dark color above, and light below. I shall soon tell you a queer thing about skates' eggs.

One of the rays is called the sting ray, because its tail extends in a huge lash, like an immense whip. Another ray is called the eagle, because his body and fins widen out on each side, like the wings of a big bird.

Another odd-shaped fin family is that of the flat fish. These, like the rays, are dark above and light below. These fish are very flat or thin in the body, and usually have both eyes and mouth on the upper or dark side. There is one kind where the eyes and mouth are so raised as to look much like the head of a bird. They swim with a queer wave-like motion of the whole body. To this family belong the turbot, flounder, plaice, and sole.

Then, too, there is a family of fish that are nearly as round as balls. They have wide stripes of light and dark color, and look more like nice play bells, furnished with tails and fins, than like fish.

A queer contrast to them is the pipe-fish. Pipe-fish have no scales. Their bodies are long and slender, like very slim canes. They get their name from the queer shape of their noses. The pipe-fish's nose is very slim and hard, and half as long as the fish. People think it looks like a pipe, or cigar.

Many fish have very odd noses. Instead of the wedge-shaped head, with the nose and mouth set exactly

on the front, the nose may be of a queer shape, and the mouth above or below.

The bellows-fish gets its name from a nose shaped almost exactly like a bellows. One kind of sturgeon is called the shovel-fish, because its head is shaped much like a wide shovel. Another sturgeon is called the spoon-bill, because its nose runs out in a long, horny plate, like a spoon, or a paddle. The hammer-headed shark, has its head broadened on each side like a great hammer, with the neck for a handle. One eye is set at the end of each projection.

I cannot tell you of all the queer shapes that fish take. If you examine those which you catch in the ponds and rivers, or see brought to market, you will observe that no two kinds are alike. What a narrow, graceful, active fish a trout is! What a queer little fellow is the fish that from his shape you call "a pumpkin seed."

I told you just now, that one ray fish has a very long tail. With it he strikes, and stuns or kills, his prey, or his enemy. Most fish live on animal food. Some fish eat sea-weeds, but most of them prefer other fish, crabs, insects, shell-fish, or other live creatures. Very many fish have some weapon for securing prey, or fighting their enemies.

Some fish depend on their quickness of motion to secure their food or escape enemies. But I will now tell you of some of their weapons. The lower lip of a salmon turns up into a sharp, cutting hook. The sword-fish has a long, hard, sharp, strong horn, which it can drive into the side of a ship. With this weapon it will also kill a man. The sword is formed by some bones of the side of the head, growing out very long and strong. The sword-fish belongs to the ray order.

Another ray is the saw-fish. This fish carries on its head a long, flat bone set with great points like the teeth of a coarse saw. With this weapon the saw-fish charges into a shoal of fishes. He maims and wounds a number so that they die or cannot swim away. Then he feasts on them at his leisure.

A very queer fish is the torpedo.[1] He is a very big fellow. He can give a shock like electricity, that stuns or kills his prey. There is a large eel which has the same power. They are both much feared by other fishes.

But no fish is more feared by other fish, or by men, than the shark. No doubt you have heard of him, with his huge mouth set with great hooked teeth.

[1] Also of the ray order.

He can kill almost any creature which is in the sea.

While much more could be said about weapons, we must now leave them to take a look at the first pair of fins, or the breast fins.

In the rays the breast fins are broad and long. They are the chief means of swimming. The flat fish have these breast fins extended all along the side of the body. By the wave-like motion of these fins and of the body they swim.

In some fish these breast fins are turned to feet, for walking at the bottom of the water. There are one or two kinds of fish that can climb trees. These have the under fins turned to sucker-like plates to help them climb.

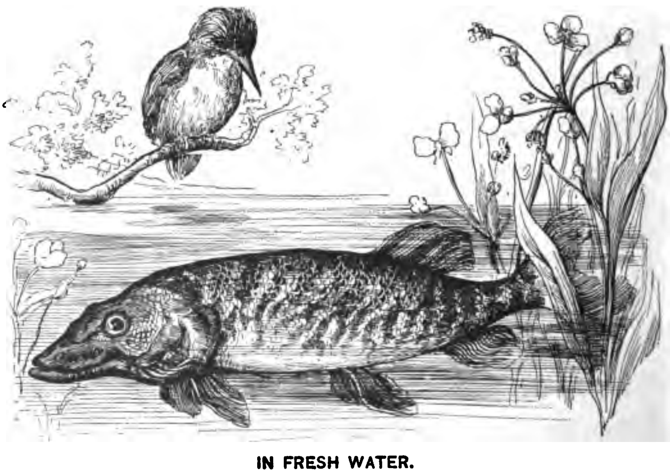
Did you ever hear of the flying fish? That fish has the breast fins long and wide like wings. The fish can rise from five to twenty feet above the water, and these fin wings support it, so that it can fly about two hundred yards. Thus it escapes from its enemies.

You will see some fish with fleshy, finger-like organs near the mouth. These are called barbels. Fish with barbels are bottom feeders. With these barbels they hunt for food in the mud.

LESSON XLII.

WHERE THEY LIVE.

WHERE does the fin family live? "In the water," you say. Yes. There is perhaps no natural body of water in the world without its fish. There are forty families of fresh-water fish. There are fish



IN FRESH WATER.

that live in water that is partly salt and partly fresh, as where the sea-tides run back into rivers. There are fish that live in the salt water of the ocean.

The ocean fish are divided into three classes. First there are the coast fish, that seldom go far from shore. They need a certain kind of food and a certain warmth of water that they find near land. Then there are surface, or upper-sea fish, that live far from land, but never very deep in the water. And there are the fish of the very deep sea.

The surface, or upper-sea fish, are most of them very strong swimmers. The deep-sea fish live far down where there is little air and almost no light. It is only about twenty years since people began to study deep-sea fish, and as yet little is known about them.

Many of the shore, or coast fish, that live in sea-water, enter the rivers to lay their eggs. They arrive in the rivers in the spring, and sometimes go up even hundreds of miles from the mouth to find safe places for their young. Thus these fish are born in fresh water, and grow up in salt water.

Among fish of this habit, we find the shad and the salmon. So you see a fish may live part of its time in salt water, part of the time in fresh, and part of the time in the brackish water at the river's mouth. Some fish, that are accustomed to spend all their lives in sea-water, can be made to live in fresh water, if this is changed gradually.

When fish live in a tank, air must be driven into the water to supply what the fish use out of it. If air is not driven in, the fish will die. As the oxygen in the water becomes scarce, the fish seem uneasy. They come up to the top of the water, and put their mouths out for air. They give a gasp as if choking.

In such tanks, where fish live, a jet of water is driven with some force into the water of the tank from above. As it goes down, you see a stream of shining bubbles. These bubbles are air. They break in the water, and the air mingles with the water in the tank.

You may see gold-fish in globes coming to the top of the water, and seeming uneasy and unhappy. Then if you dash in a little fresh water, or take some of the water from the globe and pour it back from a little height, the fish seem content.

You know that the driving winds and the tumbling waves that break in foam will keep plenty of fresh air in ocean water, for all the finny tribes that live there.

So rivers, as they rush and ripple, toss their waves, and are driven with winds, get air bubbles mixed in their waters.

Some fish need more air than others, and often come

to the surface to breathe. Some, as the sturgeon, leap above the surface into the air. Perhaps you have seen cat-fish jumping in this way. Did you ever see dolphins and porpoises[1] roll themselves quite above the surface of the water in their play? I have told you of the fish that make short flights. In all these ways these creatures help themselves to air in their water home. But what do they do for food?

As I told you, fish eat fish and insects and crabs and such living things. Some few are feeders on vegetables. Fish will also devour almost anything that is thrown into the water for them. Did you ever feed fish in a pond with bread and worms?

Carp will hurry to the top of the water to get food that they have learned to look for when people come near. Fish of a kind often keep together and feed together. You know in a stream there may be some places where you will catch only trout, or only bullheads. And in some other place you will find pickerel.

In the sea you will find millions of herring together at certain seasons. This is called a shoal of herring.

[1] The dolphin of the Mediterranean is of the whale family, and is not a true fish. The dolphin of the Atlantic is a true fish. The porpoise is of the whale family, not a true fish, but a mammal.

Fish move from place to place along many miles of sea-coast or river, as they seek their especial food, or a certain warmth.

Sometimes a particular fish, or pair of fishes, will live for years in some certain place. They may find a nice spot under a bank, where they feel safe, and where plenty of food drifts near them.

I knew of a fish that went into a hole made by the roots of a great willow-tree. The roots formed a close cage about him. He liked it well. His enemies could not get at him. Water rippled in and out about him. Grubs and worms were close to his mouth. He grew fat and big. He grew so big he could not get out. He began to grow to fit the shape of his cage. As he had no room to grow long, he grew broad.

After some years he was a very queer-looking fish. Finally, some men were making an embankment, and they came upon this fish-home in the roots of the tree. They took the fish out with care, and sent him to a pond. I fancy it seemed odd to him to swim at first, after being so long a prisoner.

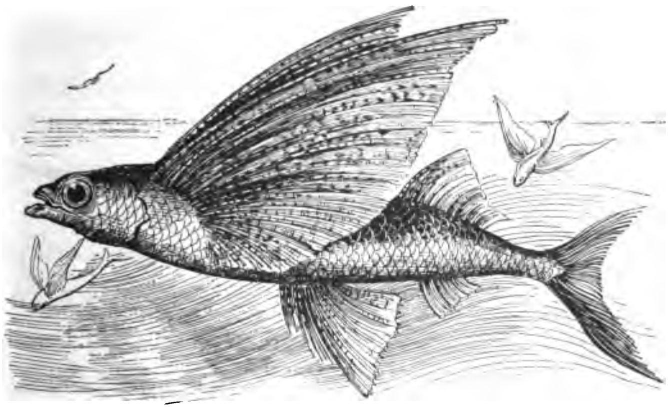
There are some kinds of fish that live and thrive in the icy-cold waters of polar seas. There are other fish that live in hot springs or ponds, where the water is so hot that you can hardly bear your hand in it.

Some fish can live only in very clean water. Others live in black and muddy streams, and their flesh takes the dark hue of their home. In fact, there seem to be some kinds of fish made to suit every kind of water. This is very fortunate, as so many birds and beasts and so many people eat fish.

LESSON XLIII.

HOW THEY BEHAVE.

BIRDS, beasts, and insects live where we can easily watch them. Wherever we go, they are our near



ABOVE THE WAVE.

neighbors. We can easily find out many facts about their way of living. For this reason, many

people, from the earliest times, have observed these creatures, and have written down what they learned about them.

But of fish, people have been able to see and know much less. It has taken much longer to learn about creatures that hide in the waters, and are, for the most part, out of our sight. Seeing fish so much less often, people took less interest in them.

Since great aquariums were built with glass tanks, in which fish can live at ease and behave in a natural way, we have learned more of their habits.

These tanks are filled with salt or fresh water, as the fish may require. The floor of the tank is covered with sand, rock, shells. Then crabs and small "shell-fish" of many kinds, and larvæ and worms are put in, such as the fish would find in their native homes.

Caves and grottos, lined with moss and weeds, are built; and the tank looks like a true part of a river, pond, or sea. Then the water is kept at the right warmth, and fresh air is driven in as I have told you. The light is made just right for the fish in the tank, and proper kinds of fish are put together.

When you go and stand outside of one of these great

tanks, this water world is before you from top to bottom. Now I shall tell you some of the things which I learned about how fish behave at home.

By such a tank I first learned that nothing can be more easy and full of grace and majesty than the motion of a fish in the water.

I watched a great fish swimming. I could not see the motion of a muscle, or the least quiver of fin or tail. His great round eyes shone; his splendid red fins were still; his spotted back glistened through the waves; his broad sides gleamed in silver mail.

He never seemed to stir from his majestic calm. He stole across the line of vision, but without visible effort. He crossed the path of other fish. He sailed above them or below them; but he seemed to feel himself all alone, and to notice nothing.

A fisher who had watched pike told me that, when he watched one lying in a pool, he was sure that the fish saw him. It did not seem to make any motion. But the fish changed its place. Soon it was gone.

In the next tank to the one I spoke of, were flounders. They swam with a wave-like motion of the whole body. They did not swim straight forward. They went up and down in curves. Their motion was

much like the flight of short-winged, heavy birds. In fact, a sole which had its eyes and mouth set upon a kind of skull-shaped head, on the upper side of the flat body, looked much like a dim, first idea of a bird.

The fish in the tank were not fish that fed on each other, and they never seemed to notice each other at all.

I saw some kinds of fish asleep. A dog-fish lay asleep on the sand, with his nose in a corner, for half a day. He looked as if he were dead. Three hermit crabs[1] were crawling about over him. He never stirred. He did not seem to notice their sharp claws and their jostling shells.

This sleeping of the dog-fish reminded me of what I had seen in pools where fish lie basking in the sunshine. Some fish are very fond of lying in a sunny spot. Others will get into a shadow, and lie there with great content.

I found in my study of fish life in tanks, that fish are given to fighting. Some of them fight with their nearest relatives. In a small tank I saw two fish that fought and bit each other so cruelly that they had to be parted.

There had been several fish in this tank, and all but

[1] See Nature Reader, No. 1, Lesson 8.

two had been killed in their battles. Then a glass partition had been put in the middle of the tank, and one fish lived on each side. They swam up to this clear wall, laid their noses against it, and glared at each other.

Another fact I remarked in fish is the clearness and keenness of their vision, and the quick way in which they will dart at food. When they see something that they wish to eat dropping down through the water, they spring at it with open mouths, and seem never to miss their mark.

When they need more air than they can get from the water, they swim to the surface and take a gulp of air and water. When they are sick, they do not swim, but lie on their sides, as if they feel too weak to make any effort. When they are dead, the bodies turn over and float on their backs.

It is said that fish can reproduce parts that they have lost, as crabs and star-fish can. At least, they can easily live when an eye or part of their mouth or a fin is gone. They seem to suffer little from such a loss. A fish that has a wound, or has just lost an eye, will swim about and eat as if it felt no pain.

Some fishes that live on the bottom have a queer way of lying close on the sand, with their mouths

wide open. They pant as if in great pain. But they are not in pain, they are sifting their food out of the water.

Look into their throats, and you will see a network, like fine bones. That is their sieve to catch small food.

Some fish are timid, and hide at the least sound. Others are fearless, and lie in plain view, or boldly follow their prey. A fish darting after his food is a fine sight. His jaws are open; his spines stand in a ridge on his back; his eyes gleam. His whole body seems alert and full of fire.

You should watch fish for yourselves. You have seen gold and silver fish in globes. Other fish are often kept in ponds and fountains as pets. They become very tame. Sometimes they learn to know those who feed them, and will come when called.

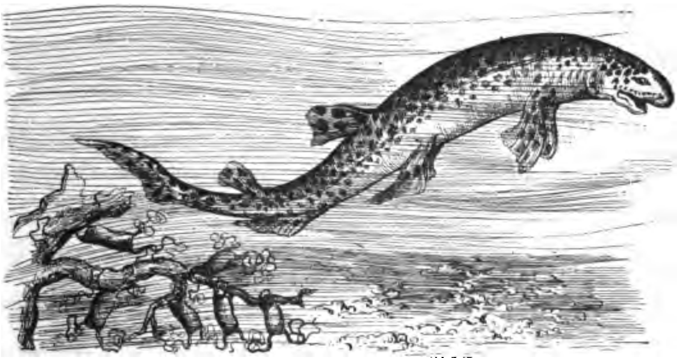
LESSON XLIV.

FRY AND SCHOOL.

A FISH comes from an egg, as a bird does. There are one or two kinds that are born as little live fishes. But the rule is that the fishes hatch out

of tiny eggs. The mother fish drops these eggs in the water, or carefully lays them in some place which she prepares for them.

After they are laid, these eggs are called spawn. Before they are laid, they lie in a solid mass together. There are many thousands of them in each mass, and they are then called roe. I have



A CURIOUS CRADLE.

told you of the wonderful number of eggs laid by insects. But fish surpass even the insects in the number of eggs.

These eggs are subject to very many dangers. Fish, crabs, and water-fowls eat them. The waves may dash them ashore, and so they will be dried up. Therefore it is needful that there should be a great many, so that after all disasters a large number may hatch.

The eggs of fish are of a pearly white, or a cream color. They are covered with a kind of glue, so that they stick together. They also stick to weeds, or rock, or sand, where they are laid.

There are very few fish that carry their eggs about with them, after they are laid. The fish presses its body against the eggs, which stick to it, and are carried about, until they hatch. You have read of the crab which took care of its eggs in this way.[1]

As the little fish grows within the egg, the soft skin-like case becomes very thin. When the time comes for hatching, the little fish breaks the case, and comes out. As a general rule, the little fish, just out of the egg, looks and acts like the parent fish. But there are some that change much between their first and their full-grown states.

Let us now look at some curious fish eggs and fish nests. Of all the fin family, the dog-fish has the most curious cradle for its young. The egg-case of the dog-fish is a horny bag, or purse. It is of a gray or blackish color, about an inch wide, and two inches long. At each of the four corners, it has a long, stiff, curly stem.

The mother dog-fish swims near the shore to lay her

[1] Nature Reader, No. 1, Lesson 3.

eggs. She selects a weed, branch, or piece of tree, lying in the water. To this she ties her egg-cases by means of their long stems, or strings. She does this by swimming round and round the twig to which she means to fasten the case. As she drops the case in the water, she ties it, or binds it, by drawing with her the curly ends, as she swims, about the branch.

She lays a number of these purses in a place. Then she swims off and leaves them. It is lucky that she does, for if she stayed near them, she would eat the little fish as soon as they came out!

I have seen a dog-fish tying its eggs to a branch lying under water, and it was a queer sight. When the baby fish has grown large enough to leave the case, it makes a little opening on one end, and creeps out.

The skate, that is a cousin of the dog-fish, lays a case much like this. But the case of the skate is of a shape more nearly square. It has four sharp, curved horns, not long, curly ends; and the little skate comes out of a hole in the middle, never at the end.

Another sea-fish, the mackerel, has no such protection for its eggs. It drops thousands of them on the water, and they look like tiny pearl beads. They

sink to the bottom. As they are sticky, they cling together, and to the sand, until they hatch.

That prettiest of fish, the trout, which lives in so many clear, shady streams, where there are deep, quiet pools to bask in, is very careful of her eggs. The mother trout sinks to the bottom of some clean stream, and selects a nice sandy place. Then, with her tail, she fans out all the coarse sand and gravel. If there are larger bits of pebble, she carries them off in her mouth.

When she has made a nice smooth little nest, like a cup, she drops her eggs into it. Then she covers them lightly with gravel, so that they will not be floated away. When she has finished one nest, she swims off to make another.

The black bass of our lakes and ponds makes a smooth bed for its eggs. It prepares this bed in the shadow of a stone or sunken log. Several bass will go together, and select and clear out such a bed. Then they will lay their eggs there, and for days, until the eggs hatch, will swim about near, to keep watch over them. Eels, cat-fish, perch, and suckers, come to eat these eggs, and the big bass drive them away.

The pretty perch does not take such care as this of her eggs. She drops them in long chains, among

grasses, and leaves of water-plants, at the edge of the pond. When the yellow cowslips are in bloom, you can find these eggs among the water-plants, like strings of fairy beads.

When the baby perch come from the eggs, they are very nimble, and begin at once to eat. When they are no longer than the nail of your little finger, it is funny to see them in the water, darting after the living atoms that serve them for food.

They see and know these tiny things in the water, and pounce upon them with wide-open mouths.

The little fish, from the time they are out of the egg, until they are about half grown, are called fry. Some fish, as the salmon, get different names at different periods of their growth. A great many fish together are called a school. Thousands of fish will come leaping, rolling, and tumbling along in the water, and we say it is a school of fish.

LESSON XLV.

SCALES AND TEETH.

I TOLD you that most fish had scales, and that these scales clothed them in a gleaming, flexible suit of armor. Most of the beautiful color of fish is

found upon their scales. Many of the scales are iris or rainbow hued. That is, they have the gleam of many colors, according as the light strikes them. Have you not seen such colored light in a glass prism?

The scales of different fish vary in shape, size, color, and hardness. In general, they are horny like your finger nail, but thinner. Their shape is nearly round, much like a rose petal. They are fastened by the smaller edge to the skin of the fish. Then each scale laps over the next one, and so on.

Scales are always so set that they turn or lap, from the head toward the tail. In the middle of each scale, on the lateral or side line of the fish, is a little groove or canal. It runs in the direction of a line from head to tail. Let us see what it is for.

Have you noticed how slippery fishes are? Is it not hard to hold them? If you rub your finger hard down their bodies, you rub off a quantity of slime, or stuff like glue, or thin paste. This glue-like stuff is made near the mouth of the fish. It is supplied to the scales by little tubes near the mouth. It runs through that little canal in each scale in a line upon the side of the fish.

This slimy stuff helps the fish to slide easily through the water. It keeps the scales limber and healthy.

It keeps the body supple. It helps the fish to slip away from creatures that seize it. Also, I am sure, it helps the fish to slide easily down the throats of birds, animals, or fish that capture it!

The fact that the scales all lie turned from the head to the tail of the fish, also makes it easy for birds or other fish to swallow it. But if a fish is partly swallowed, it cannot be readily cast out, for its scales rising, make a rough surface, and hinder it. I suppose that was why the alwife duck I told you of could not get the partly swallowed fish out of her throat.

Each kind of fish has its own especial shape and color of scales. Some are pointed, some are rounded, some are flat, some are curved, some are three-cornered. Some fish have no scales. Some have such tiny ones that you will not notice them unless you look sharp. Some fish, as the sturgeon, have great bony plates, like large limpet shells, laid in lines up and down the body.

Fish not only have their own especial shape of scales, but their especial color, and such colors have their especial place on the fish. One flat, brown fish has all the under side of its body white, but spots of red, like sealing wax, are laid all over the brown side, as if you had dropped red wax upon it.

When you see a smoked and salted herring hung up for sale, you are not likely to guess what a beautiful thing it was, when living in its water home. It had a coat of blue, green, and silver, and gem-like eyes. The eye of a dead fish is sunken and dull. The eye of a living fish is full, and gleaming with light.

There is a little fish called a wrasse which looks as if made out of a rainbow. It is dressed in bright blue, gold, bronze, and white.

The red bream is of a fine rose-red color, with silver sides. Its luminous eyes are set in golden rings. The perch has dark, shining bands on its silver coat, and it has gay, red fins. The gray mullet is a quaker fish, trim, grave, quiet in its style, but lovely in its shape and in the rainbow lights along parts of its body.

Once I saw in the water a fish called a gurnard. He seemed to have borrowed a sunset to dress himself in. His scales were deep red and bronze. There was a vivid blue on the edges of his fins. The fins were in shape and coloring like a butterfly's wings.

I never saw a boy who did not think that a trout was one of the prettiest things ever made. Very much of the beauty of fishes lies in the wonderful scales.

But you must examine scales for yourselves. If you have a microscope to look at them with, you will be full of delight and surprise at what you see. Once I looked through a very powerful microscope, and thought I was looking at a lump of half-melted gold set full of fine jewels. But it was the scale of a fish.

I will now leave the scales, and tell you a little about the teeth of fish. Fish have a great many teeth. Their mouths are for the most part hard and horny, and so covered with teeth that it is not likely that they have very much sense of taste. Still there are some kinds of fish that are almost, if not quite, toothless.

If you open the mouth of a sea-trout you will find that it is set entirely round, with sharp, strong teeth. Then if you stretch the mouth open and look into it, you will see that there is another row of teeth set all round a bone inside the upper jaw. Look still farther in, and you will see a row of teeth on the middle bone in the roof of the mouth. Look still beyond, and you will see a row of teeth on each side of the tongue.

Some fish, besides all these teeth, have the tongue quite covered with teeth. Others, that eat vegetables, have little fine teeth all down the sides of the

throat. The French call such teeth as these, "teeth in the velvet." Some fish have the entire mouth and throat lined with teeth.

These teeth may all be alike, not some "double" and some "single" as you have. But sometimes fish have teeth of different patterns. The most common form of teeth in fish that live on fish or other animal food, is that of a slim cone, bent a little inward to hold firmly the fish caught, so that it cannot slip away.

The fish that feed on weeds have short, roundish teeth with a flat top, to make a good mill with which to grind or crush their food. Fish that eat insects do not need such large teeth. They have a great number of little teeth almost as fine as hairs. Rows of these teeth look like a little brush.

Some fish are said to have "mill" teeth, as the carp, because their large flat teeth roll upon each other like the stones of a mill grinding grain.

The ray fish, that feed on crabs, shell-fish, and flat fish, need very strong teeth for crushing such food. If you should look into their mouths, you would see that they are made like a mill, and the upper and under teeth roll against each other and crush fine all that is between them. By looking at the mouth of fish and examining its teeth, you can

find out what kind of food it used, just as by looking at the beak and claws of a bird, you can tell what were its habits and food.

Some fish have the inside of the stomach thick and furrowed, very like the gizzard of a fowl. This is to aid in cutting or grinding up the food. The teeth of a carp have much the appearance of the teeth of sheep and cows, only they are much smaller. They work against a plate of gristle in the roof of the mouth and reduce the food to pulp.

The strong, sharp teeth of fish are used not only for eating their food, but for biting and fighting other fish. Two great salmon have been known to fight until one was killed. The dead one was found to be badly wounded and torn by the teeth of its enemy.

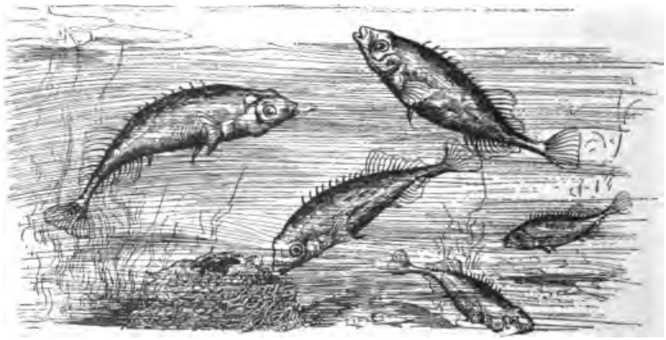
Pike have very sharp, strong teeth, and a big pike has been known to seize hold of the foot or nose of a dog, fox, or other animal, that came to the water's edge to drink.

The mouth of a dog-fish is set back on the under side of the head. This mouth has a row of strong, sharp teeth all round it. When the fish seizes its prey or its enemy with its teeth, it whirls itself over, and this action enables it to tear out a large piece of the flesh held by its teeth.

LESSON XLVI.

BIG AND LITTLE BROTHERS.

YESTERDAY, as I was going along the street, I saw a large globe full of tiny fish. They were from one to two inches long. I stopped to examine them. They were sticklebacks. You must know that little Mr. Stickleback is a very pretty and curious fellow, and well worth buying.



THE LITTLE HOUSE BUILDER.

Looking into this globe made me think of some of the queer things I have heard and seen of this little fish. Shall I tell you about him?

The stickleback gets his name from the fact that some

of his fins, one on the back and one on the lower part of the body, have changed to spines or thorns. Different kinds of stickleback have three, four, ten, fifteen, of these thorns.

This little fellow is one of the smallest and prettiest of fishes. He is slender, and from one to three inches long. The general length is about an inch and a half. His body is silver below, green and purple in bands on the back, and red and gold on the head and sides. His fins are thin as finest silk. I never saw a prettier little creature.

The stickleback is very greedy, very fearless, full of courage, very affectionate, and of all fishes is the most devoted parent. Finally, the stickleback can build a house.

The colors of the stickleback brighten or fade according as he feels glad or sad. If he has lost his mate, his home, or his young ones, or if he has been beaten in a fight, he swims off to hide, and his colors grow dull. If he has beaten his enemy, if his children and mate are quite safe in the little house where he has put them, he gleams and glows like a rainbow.

Sticklebacks are so fearless that when they are in a pond no noise or shadow will alarm them. You can even catch them without a hook just by

dropping among them a string with a worm on it. You may pull up the string with two sticklebacks fast, one on each end of the worm. Little English boys take this way of catching these tiny fish for their globes.

When put into a globe or box, they fight sharply at first. They strike each other with their spines, whirl, dart, pretend to be beaten, and then leap back to the fight. They are real little soldiers. Finally, when they have found out which of them all is the strongest, each one chooses his own corner, or shelter by a stone for a home, and defends that against all strangers.

The different varieties of sticklebacks build different kinds of houses. One makes a nest like a muff among water-weeds. I will tell you of one kind of nest. The little fish carries straws and bits of grass and moss, and tucks them down into the gravel and sand. He glues them with the glue from his skin.

While he is at work he holds and carries his material with his mouth, and presses it into place with his body. Having laid a floor, he builds a little hut of woven fibres and moss. This hut is about as large round as a twenty-five-cent piece. A little door is at the top. He tries the strength of his

house by stirring up the water near it with his tail.

When all is done Mr. Stickleback swims off to find his mate. He seems to tell her that the house is ready. She is a lazy little creature, and does nothing but frolic in the water. She goes along to the new home, and goes in to lay some eggs there. Mr. Stickleback proudly swims up and down before the home to keep foes away.

The little mate being fond of play does not like to stay in the house long. She lays a few eggs about the size of poppy seeds. Then she bites a hole in the house and runs away! Next day little Mr. Stickleback goes to find her, and coaxes her back. This goes on for several days, until a great number of bright yellow eggs, like seeds, are laid in the nest.

After this, it is a whole month before the little fish will hatch. Meantime other fish and other sticklebacks will eat them, if they get the chance. All that month the kind, brave little stickleback swims up and down near his nest, and drives off enemies. He will let no fish, not even his mate, come near his treasure.

Finally, out come the wee, wee fish. Now the poor little father has a harder time than ever. The

other fish want to eat up the young fry. The food of sticklebacks is grubs, tiny insects, and very small fry. As they are very hungry and greedy, they are on the watch to pick up the new little fish. But the stickleback, however hungry, never eats his own little ones. He leaves such vile conduct to the dog-fish.

As the little ones grow, they are very active, and want to stray away from their home. Their father knows they would get into danger, so he watches, and chases each runaway back into its home bounds, where he can take care of them all.

Finally, the little ones are so nearly grown that they can fight for themselves. They can pick up their own food, and make their own houses. Then they are allowed to go off and swim where they choose.

As I have told you about a very little fish, I will now tell you something of a very big fish. The sturgeon is a great fish which lives in the waters of many countries. He is found in some of our rivers. The body and head of the sturgeon are partly covered with five long lines of great bony plates. These plates are grooved, and have a sharp point in the centre. They make good armor.

Sturgeon are fond of playing and leaping from the water. They are often speared by people standing on rocks or in boats. I have seen very big ones taken from the Niagara River. In the Ohio and Mississippi the curious spoon-bill or paddle-fish sturgeon are found. In some of our other rivers the shovel-headed sturgeon lives.

The flesh of the sturgeon is good for food. The Russians make isinglass from the air bladder of the sturgeon, and one or two kinds of food are prepared from its roe and flesh. Of the isinglass prepared from the sturgeon, jelly is made. Glue is very plentiful in the skin and bones of the sturgeon, and a kind of food is made from the spinal marrow.

I need hardly tell you much about the uses of fish. You all know that they form a large part of the food of men, and many birds and beasts. Glue is made from fish-bones and skins.

From many fish are made those substances that I told you farmers put upon their land to restore the minerals eaten out by the plants.

Oil is also made from fish. From parts of the cod an oil very useful for medicine is obtained. From other fish, lamp oil and machine oil are pressed. A little fish in the Caspian Sea is so oily that when

it is dried its body burns with a clear light. These dried fish are used as candles. When the Cossacks get hungry, and have nothing else for supper, they eat their fish candles.

That terrible fish, the shark, is very useful after he is dead. From his fins, fine gelatine is made. From his skin, a leather-like substance called shagreen is prepared. Shagreen is used in polishing wood, and for covers of portfolios, instrument-cases, and the like.

From the bones of the shark, buttons and ornaments are made, and very costly canes from his backbone. His teeth are very hard and white, and are often mounted in gold and sold for ornaments.

There are many large and interesting books about fisheries, manufactures of articles from fish, and about the various kinds of fish, and their habits and uses. I hope you will try to get some of these books to read. In fact, I hope you will pursue for yourselves all these studies in nature which we have begun in the Nature Readers.

REVIEW LESSONS.

I.

1. What are some of the things which we get from the earth?
2. Why do we say "Mother Earth"?
3. What do we say are the eldest children of Mother Earth?
4. What is a plant?
5. What is the chief food of plants?
6. What are some of the things that plants can do?
7. How do animals get most of their mineral food?
8. Do plants take their food in liquid or solid form?
9. What partners have plants taken?
10. What is the business of plants?
11. What good does that business do us?
12. How large are some of the largest plants?
13. How small are some of the smallest plants?
14. What can you say of the length of a plant's life?
15. What two great divisions of plants are there?
16. What are the six parts of a perfect plant?
17. What is a tendril?

18. Are any of the parts of a plant ever wanting?
19. Of what use to a plant is the root?
20. What are tbe true roots of plants?
21. What are these thicker parts which are usually called roots?
22. What is a plant stem? Of what use is it?
23. Tell me something about leaves.
24. With what does a plant begin and end?
25. Have plants more than one crop of seeds?
26. What is an annual plant?
27. Will you describe the sprouting of the seed?
28. What is a stamen?
29. What is a pistil?
30. Describe the seed-case.
31. What are the only really necessary parts of a flower?
32. Where does the growth of a plant begin?
33. What is a hardy seed?
34. How do plants grow?
35. What can you say about the plant's need of moisture?
36. What is the blood of the plant?
37. What two kinds of sap are there in a plant?
38. Tell me about the tubes and cells.
39. Through what does the plant breathe?
40. How does the sap get changed in the leaf?

41. What can you say about starch in plants?
42. What about sugar?
43. How does the plant prepare mineral food for you?
44. Will plants thrive in the same soil year after year?
45. How does the farmer rest his fields?
46. How does he give more food in the fields to the plants?
47. What is a seed?
48. Describe an egg.
49. Describe a seed.
50. What can you say of the shape and color of seeds?
51. How are seeds carried about?
52. Tell me something about leaves.
53. Tell me how plants breathe.
54. What is the work of leaf-green?
55. What about carbonic acid gas in the air?
56. What is the plant's work in purifying the air?
57. What can you tell me of color in plants?
58. What are some of the dyes we get from plants?
59. What motions have plants?
60. What is the cause of motion in plants?
61. What can you say of climbing plants?
62. Describe the strawberry plant.
63. Describe the walking fern.
64. What can you tell me of coal?
65. What is the use of pollen in the plant?

66. Are stamens and pistils always in the same flower?
67. What is necessary to the production of good seed?
68. How do insects convey pollen from flower to flower?
69. What has the flower to tempt insects?
70. What has the plant to keep away certain insects?
71. Tell me about the methods of insects in getting honey.
72. What plants have the pollen carried by the wind?
73. Why does the insect visit the flower?
74. Of what color are the flowers that need night-flying insects?
75. What can you say about the scattering of seeds?
76. How are some seeds blown about?
77. How do birds help in carrying seeds?
78. What is there about seeds to attract the birds?
79. What can you tell me of air-plants?
80. How do they get their nourishment?
81. Tell me something about water-plants.
82. What two shapes of leaves do some water-plants have?
83. Of what shape are most of the leaves that grow under water?
84. Why do they have these fringe-like shapes?
85. Of what shape are leaves that lie upon the water?
86. What kind of leaves have plants that grow in sand?

87. What use do these leaves serve?
88. Why are most plants that grow in sand prickly?
89. What can you tell me of a cactus-plant?
90. What long name have animal-eating plants?
91. What kind of living things do these plants catch and eat?
92. Tell me about the sun-dew.
93. Tell me about the Venus's fly-trap.
94. Tell me about the pitcher-plant.
95. How do plants foretell changes in the weather?
96. What plants are the best weather prophets?
97. What is the reason of this closing before rain?
98. Of what use is this habit to the flower or seed?
99. Describe a flower clock.
100. Tell me about the hours when some plants open and close.
101. Will these hours of opening change with the time of year?
102. What is it that causes this opening and shutting?
103. Tell me about the sleep of leaves.
104. Of what use is this sleep to the plants?

II.

1. Describe a grasshopper.
2. What is the meaning of his various names?
3. How does the grasshopper make his music?

4. What can you say of Mrs. Grasshopper's sword?
5. Do all grasshoppers live in the grass?
6. Are the head and chest of an insect in the form of rings?
7. To what order does the grasshopper belong?
8. How many straight-wing families are there?
9. How are they sometimes divided?
10. Tell me about the grasshopper's legs.
11. Describe his wings.
12. What do grasshoppers eat?
13. Where are the grasshopper's eggs laid?
14. Tell me how the grasshopper changes from egg to full-grown grasshopper.
15. Can you tell me of any of his queer ways?
16. Describe some grasshoppers to me.
17. Does the grasshopper migrate?
18. Does the grasshopper live alone?
19. What insect is the robber cousin of the grasshopper?
20. Tell me how a locust differs from a grasshopper.
21. What can you tell me of the numbers of locusts?
22. Tell me what harm locusts do.
23. What means are taken to destroy them?
24. What can you say about their size and color?
25. What insect is the grasshopper's merry cousin?
26. Describe a cricket.

27. What three kinds of crickets are there?
28. What difference is there between the house and field cricket?
29. What will crickets eat and drink?
30. Tell me how the cricket plays his tunes.
31. Tell me about the life of a field cricket.
32. Describe a mole cricket.
33. Describe a mole cricket's nest.
34. Tell me something of the mole cricket's habits.
35. What is it that makes the mole cricket shine sometimes?
36. Why has the mole cricket been called the earth crab?
37. In what is the mole cricket like a mole?

III.

1. To what order of insects do the frog-hoppers belong?
2. What can you tell me about insects of this order?
3. Will you mention some of them?
4. What can you say about their wings?
5. How does the little frog-hopper make the ball of foam?
6. Of what use to him is this ball of foam, or froth?
7. What does the scale bug make for his covering, instead of froth?

8. Which is the largest insect of this order?
9. What name has he besides cicada?
10. Which of the insects of this order is the ant's cow?
11. Which one carries a light?
12. On what food do all hoppers feed?
13. Where does the cicada lay her eggs?
14. Why does she not put them in a living branch?
15. How does she make the hole in which to put her eggs?
16. Where do the larvæ of the cicada live?
17. What kind of weather does the cicada like?

IV.

1. To what insect order do moths and butterflies belong?
2. How do the feelers of butterflies differ from those of moths?
3. How does the butterfly hold its wings, while at rest?
4. Which side of the butterfly's wings is more gayly colored?
5. Why is this?
6. How does the moth hold its wings while resting?
7. What are the butterfly's wings often called?
8. Which has the thicker body, a butterfly or a moth?

9. Which has the more furry coat?
10. Which usually flies by night?
11. Do butterflies ever fly by night?
12. What is the food of these insects?
13. How do bees get honey from flowers?
14. How do they carry this tube when it is not in use?
15. Will you describe this tube?
16. What can you say of the butterfly's legs and feet?
17. Will you describe the wings of a butterfly?
18. Why is the butterfly the best partner of the flower?
19. Why have butterflies been so much studied?
20. Where are the eggs of butterflies laid?
21. Tell me about butterfly eggs.
22. What is the creature called that comes from a butterfly's egg?
23. Describe a caterpillar.
24. What is the first act of a caterpillar, after leaving the egg?
25. What does the caterpillar eat?
26. What can you tell me of the horns of the caterpillar of the swallow-tail butterfly?
27. Why is this butterfly called by this name?
28. What is a girdle caterpillar?
29. How does the caterpillar pass into the pupa state?
30. What, then, is a caterpillar? (It is a butterfly larva.)

31. What effect has the weather on the pupa state?
32. Tell me how the butterfly leaves the pupa case.
33. How does a butterfly spend its time?
34. What does it do in bad weather?
35. Do any butterflies live over winter?
36. How do some caterpillars make a house for the winter?
37. Where is the silk-spinner of a caterpillar?
38. Why does a caterpillar make that sidewise motion with his head?
39. How do some caterpillars build a home for summer?
40. How do some spin or weave a hammock?
41. What can you tell me of the colors of butterflies?
42. Why are these insects called scale-winged insects?
43. What can you tell me of the hawk-moth?
44. In what is it like a humming-bird?
45. Why is one moth called a death's-head moth?
46. Tell me about the wasp moth.
47. Where does it stay in the pupa state?
48. What is the bombyx?
49. Tell me all you can about the silk-worm.
50. Does the silk-worm moth ever eat?
51. Tell me about its caterpillar and its cocoon.
52. Which moth destroys furs and woollen goods?
53. Tell me about the tinea.

54. What can you tell me of the beauty of moths?
55. How can you capture moths to study or to keep?

V.

1. What is a bird?
2. How are eggs hatched?
3. On what plan is a bird built?
4. What can you say of a bird's bones?
5. What can you tell me about a bird's neck?
6. How do the bird's bones help to keep it up in the air?
7. What shape is the breast-bone of flying birds?
8. What is the shape of the breast-bone of birds that do not fly?
9. In which part of the bird's wing is the chief length?
10. Which is the short bone of the leg?
11. How many toes have most birds?
12. What is a bird's beak?
13. Have birds any teeth?
14. What have they instead of teeth, for grinding their food?
15. What are a bird's short feathers called?
16. Are any places on the body bare of feathers, and why?
17. What can you say of the large feathers?

18. Can birds move their feathers?
19. What else can you tell me about feathers?
20. Why do birds preen or dress their feathers?
21. What can you tell me about the feet of water birds?
22. What can you say about wading birds?
23. What kind of a bill has a duck?
24. How and why does it differ from a hen's bill?
25. How are the beaks of fish-eating birds formed?
26. What can you learn of a bird's habits from examining its feet and beak?
27. What can you tell me about the ostrich?
28. Why is the pigeon such a thirsty bird?
29. How does a swallow feed?
30. Tell me of the shrike, or butcher bird.
31. What different kinds of food do birds eat?
32. What can you tell me of the woodpecker family?
33. Will you tell me how and why birds migrate?
34. Tell me the history of the bobolink.
35. Describe an oriole's nest.
36. Tell me about a humming-bird's nest.
37. How do some birds ornament their nests?
38. Do birds ever build a roof over their nests?
39. What are some of our best singing birds?
40. What can you tell me of the blue jay?
41. Tell me how birds care for and defend their young.
42. What birds lay eggs in other birds' nests?

43. What are some of the enemies of birds?
44. What birds can be called street and field cleaners?
45. Tell me any curious things you have seen or heard about birds.
46. Mention some of the lost birds.
47. How did these birds become extinct?
48. What are the different families of the parrot tribe?
49. In what countries do parrots live?
50. What can you say of their food and habits?
51. Where do canaries come from?
52. Of what color are they in their wild state?

VI.

1. On what plan is a fish built?
2. In what element do fishes live?
3. Where do you suppose men got their first boat patterns?
4. What fish is usually described as a pattern fish?
5. Will you describe a perch?
6. What part answers to the boat's prow?
7. What part serves for a rudder?
8. How many fins has a perch, and where are they?
9. Which fin is used chiefly for motion?
10. What can you tell me of the eyes of the fish?
11. What use do the gills of a fish serve?

[illegible]

Name them.

[illegible]

What is [illegible]

[illegible] largest fishes?

[illegible] smallest?

[illegible] in form?

[illegible] differ in regard to their eyes?

[illegible] have no scales?

[illegible] fish have instead of scales?

[illegible] fish of the ray family?

[illegible] that fish.

[illegible] odd forms of fish do you remember?

[illegible] some queer forms of fish heads and

[illegible]

36. What are some of the weapons of fish?
37. For what do they use these weapons?
38. What can you tell me about the breast fins of fish?
39. To what do the breast fins sometimes change?
40. How are fishes able to climb trees?
41. What do you know about flying fish?
42. What are barbels?
43. What fishes have barbels?
44. Where do the fin family live?
45. How are sea fishes divided?
46. Do fishes ever go from salt to fresh water?
47. For what reason do some fish leave the sea and ascend rivers?
48. Tell me how air is put into tanks of water for fish.
49. How do fish behave if they have not enough air?
50. How does air get into the water of seas, lakes, and rivers?
51. How do fish sometimes help themselves to surface air?
52. What do fishes eat?
53. What is the basking of fish?
54. How are fishes kept in glass tanks?
55. Tell me of some of the queer ways of fish.
56. What about the fighting of fish?
57. How does a fish act when he darts after his food?

58. What are fish eggs called before they are laid?
59. What are they called when first dropped in the water?
60. What are the little fish called soon after they hatch?
61. What do we mean by a school, or shoal, of fish?
62. What can you tell me about skate and dog-fish eggs?
63. How will you know the egg-sacs of a skate from those of a dog-fish?
64. How do the mackerel and herring leave their eggs?
65. What can you say of the numbers of the eggs of fish?
66. What kind of a nest does the trout make for her eggs?
67. Where and when can you find perch eggs?
68. What can you tell me of the shape and colors of scales?
69. What can you tell me of the scales of the side line of the fish?
70. Of what use is this slipperiness to a fish?
71. Why is it hard for a bird or fish to get a partly swallowed fish from its throat?
72. Tell me about some pretty fish.
73. Have all fishes teeth?

74. What can you say of the number of teeth in many fishes?
75. Where are these teeth set?
76. What do the French call "teeth in velvet"?
77. What can you tell me about the shape of fish teeth?
78. What kind of a fish is a stickleback?
79. How have some of his fins changed?
80. Tell me about the way sticklebacks can be caught.
81. Tell me something of their habits.
82. How does the stickleback build his home?
83. What do the eggs look like?
84. How does this little father take care of his family?
85. What is one of our largest river fish?
86. How are sturgeon often caught?
87. What do the Russians make from sturgeon?
88. What kind of candles do the Cossacks often have?
89. What are some of the things made from the shark?
90. What can you tell me about the shark?
91. Of what use are fish?
92. How can you learn more about fish?
93. Why in these Readers have you been told a little of many things?
94. Do you think you know a little about how to use your eyes as you go about the world?

Geography.

"The peg upon which the greatest quantity of useful and entertaining information may be suspended."

Progressive Outline Maps,

Of North America; South America; Europe; Central and Western Europe; Asia; Africa; the United States; New England; Middle Atlantic States; Southern States, Eastern Division; Southern States, Western Division; Central States, Eastern Division; Central States, Western Division; Pacific States; Great Britain; England; the World on Mercator's Projection; Greece; Italy; Germany; France; and Ancient History (The World as known to Ancients). Printed on substantial drawing paper, and adapted to lead-pencil or to ink. 10 x 12 inches. U. S. and Mercator's Projection, 12 x 20 inches. Ancient History Map, 12 x 15 inches. Price by mail, 2 cents each; or, $1.50 per hundred. Map of Ancient History, 3 cents each; or, $2.50 per hundred.

THESE outlines are for the use of the pupil, and are based on the assumption that map-drawing should be taught as a means, and not as an end; that its purpose is to assist the mind in acquiring and fixing geographical facts, and that to memorize the construction lines of other methods and the hundreds of nameless projections and indentations of a tortuous coast-line is a waste of time and of nervous energy which would be better employed in studying important and interesting particulars concerning the physical features, climate, products, etc., of the interior.

In *tracing the outline*, the pupil acquires a correct knowledge of the form of the country, and, as each day's lesson proceeds, he can fill in his map to correspond with the detailed knowledge gained.

The figures on pages 8 and 9 represent in miniature an outline as given to the pupil, and the same as it appeared when the study of the country was completed.

Among the advantages of the **Progressive Outline Maps,** we may mention the following:—

1. Economy of time. By using the **Progressive Outline Maps** all the practical benefits of map-drawing are secured. By tracing the dim outline, and then developing a continent along such special lines as

the teacher may direct, every *important* feature is clearly fixed in the mind of the pupil, in as little time as is ordinarily consumed in memorizing the construction-lines and diagrams of other systems; and the still longer time required to memorize the irregularities of a contour can be devoted to the study of the more important topics of surface, climate, productions, etc.

2. **Economy of energy and patience.** A large amount of energy is expended by the pupil who makes an original development of the outline of even one continent. The work usually becomes uninteresting, and discouragement begins before the map is half completed. By using the **Progressive Outlines**, however, he proceeds with more rapidity and accuracy, and at the same time does so much original work, that he is pleased and encouraged. Nor is the teacher's patience so severely tried by efforts that in the end are only nondescripts.

3. **Accuracy.** They keep a *correct* form of the country under consideration constantly before the pupil.

4. **General usefulness.** (*a*) These maps may be used to indicate, besides the usual facts of indentations, projections, mountains, rivers, countries, states, towns, etc., the locations of areas of mineral deposits, of forest growth, of prairies, deserts, plateaus, of the various kinds of soil, of staple products, of dense population, of manufacturing districts, etc.

(*b*) For developing the features of continents, made specially prominent in Physical Geography, these maps are very valuable.

(*c*) In connection with the study of Ancient History, these maps may be used to represent the location of ancient tribes and barbarous hordes of men, the provinces of ancient empires, the distribution of territory after conquests, etc., etc.

(*d*) In Modern History the maps of North America and the United States may be used for indicating the early discoveries, the settlements and the general development of the continent, the colonies and the nation, in connection with the text-book study of these features. No time can be spared in History for *practice* in map-drawing.

(*e*) For rapid and thorough tests of pupils' knowledge of Political, Descriptive, and Physical Geography, and of many facts in History, no series of questions and answers can equal in three hours what may be ascertained, practically, of their knowledge of these subjects by these **Outlines** in thirty minutes. Such a map can be easily and rapidly inspected by the examiner.

Expressions from prominent teachers, who have already successfully used these maps with classes for these purposes, indicate a decided preference in their favor, and a positive unwillingness to return to the imperfect outlines constructed by the pupils themselves.

5. **Economy in price.** These maps cost the pupil two cents each. Several times that amount is usually expended for paper required for the practice in producing a satisfactory map by other methods.

DIRECTIONS FOR THE USE OF THE PROGRESSIVE OUTLINE MAPS.

MANY ways of using the **Progressive Outline Maps** will suggest themselves to teachers. A practical teacher who has used them for some time has kindly prepared for us the following directions descriptive of his own method. These directions are for advanced classes, and include the less within the greater.

Teachers in the lower grades can readily modify or omit as the condition of their classes may demand. Colored inks and pencils are recommended.

The great object of the **Progressive Outline Maps**, as of all map-making, is to help the pupils to remember the important facts of geography. Maps should therefore be developed in connection with the subject as it is studied.

One or two lessons are given to the study of the contour of a country from the text-book, and then the **Progressive Outline** is placed in the hands of the pupil.

1. The pupil now traces the outline with pen or pencil, and afterwards reads the same as a lesson in cipher, telling where the country is with reference to zone circles, other grand divisions, and the oceans bordering upon it; also mentioning its general shape, the important projections and indentations.

He next prints their appropriate names, against the features, or, if a member of a lower class, writes them. Two or three short lessons in printing, with a few minutes' practice, will greatly facilitate this work, and enable the pupil to present a nicely made map.

2. After the surface has been carefully studied, the mountains, peaks, and volcanoes are drawn in the map from the text-book, with such changes as the teacher directs. The names of these chains, etc., should be written or printed as they are drawn.

READING.

Suggestive Lessons in Language and Reading:

A Manual for Teachers. By ANNA B. BADLAM, of the Rice Training School, Boston. Illustrated. Cloth. 288 pages. Retail price, $1.50. Intro. price, $1.20.

Plain, practical lessons, being a transcript of successful work done in the school-room.

THE work is intended for children from five to eight years of age, the plan being so elastic that it may be used in any of the primary grades.

The first part of the book is devoted to *Outline Lessons for Oral Work*, to specimens of stories told by children who had had this work, and to a collection of simple fables for reproduction by the pupil.

The second part of the book is devoted to *Suggestive Lessons* for blackboard reading and word building. The plan embraces the best known features of the various methods of teaching reading. The Lessons are illustrated by pictures in outline, so *simple* that the teacher will be able to reproduce them on the blackboard when teaching the text of a lesson. The plan for reviews is also an important feature. A chapter on the drawing of simple objects is appended, as an aid to teachers. The appendix gives a series of miscellaneous exercises in oral language.

J. J. Mapel, *Pres. State Normal School, Milwaukee, Wis.:* I rejoice in its advent as indicating the promise of better things in elementary, and, in consequence, better things in higher, education.

E. H. Russell, *Prin. of State Normal School, Worcester, Mass.:* It well bears out its felicitous title; and I believe will stand the difficult test of use by teachers much less skillful than the author.

H. A. Luddington, *State Normal School, New Britain, Conn.:* I am greatly pleased with it. The leading idea is novel, and is skillfully worked out. It is just what it claims to be — suggestive — and will be, I am sure, very helpful to teachers. The phonic work is invaluable.

Sarah A. Stewart, *Prin. of Normal Kindergarten Training School, Philadelphia:* It meets my entire approval. It is the most complete book of the kind I have ever seen. Our pupils ought to be well grounded in English when they get through it. I hope to see it used generally.

A Primer and Elementary Reader.

By ANNA B. BADLAM, of the Rice Training School, Boston.

THIS iittle work is intended to supplement the Board Reading Lessons of the Teachers' Manual, entitled "Suggestive Lessons in Language and Reading," which we have recently published.

Its chief features are: —

1. A series of Introductory Lessons, mainly objective, designed to be used as topics for simple conversation, to accustom the child to express the thought suggested by the illustration and the text in an easy manner and a natural voice. Some of these lessons are duplicated in script, thus serving as copies for slate-work.

2. Gradual progress in the length and difficulty of the Reading Lessons.

3. The substitution of new and interesting stories for practice upon a vocabulary in place of the usual so-called "Review Lessons," that frequently consist merely of detached, disconnected sentences which can have no special interest for the child.

4. Variety in the style of expression, to accustom the child to read with equal ease description, narration, or conversation.

5. Natural sentences. Particular care has been taken to avoid an unnatural brevity of expression, that can but result in a disagreeable, abrupt manner of reading.

6. The presentation of new words and phrases as an introduction to each lesson or series of lessons.

7. The frequent introduction of "Sound Lessons" for the purpose of vocal drill.

8. Simple slate-exercises as a supplement to each lesson.

9. Elementary writing lessons which introduce the letters in the order of difficulty.

10. Utilizing throughout the entire text the natural guides to pronunciation by (*a*) joining any two modifying consonants or vowels to indicate that they are to be sounded together; (*b*) aiding the child to recognize silent letters by means of the hair-line letters, first adopted by Dr. Edwin Leigh, and by whose permission they have been here used; (*c*) indicating, by a judicious use of diacritical marks, such intricacies of the language as would puzzle the child and retard his progress, unless some aid were given him to take the place of the intuition and judgment that serve as aids to older minds.

An Illustrated Primer.

By SARAH FULLER, Principal of the Horace Mann School for the Deaf, Boston. $5\frac{1}{2} \times 7\frac{1}{2}$ inches. 107 pages. Boards. Price by mail, 30 cents; Introduction price, 25 cents.

THE aim of this little book is to familiarize young deaf children with the printed forms of words and sentences which they have learned to speak and to associate with objects. Selected words containing all of the vowel and consonant elements furnish a guide to the child in learning new words. These are followed by sentences introducing the verb *to be;* prepositions; adjectives, denoting color, number, size, form, and quality; personal pronouns, with the verb *to have.* The illustrations are in simple outline, representing only the objects named and the statements given. The book closes with a few, short, illustrated reading lessons.

This combination of picture-book and primer is adapted to use in the nursery as well as in the schoolroom, and should find its way into the homes of all little children.

The preface and a few pages of the book are appended to show more fully its design and general arrangement.

PREFACE.

THIS primer is intended to help little children who are deaf, in their earliest language lessons. They are supposed to have learned to speak and to associate the words they utter with the objects represented in words. Here, in this volume, they find the printed forms of the words which they speak, and of the sentences which they have been taught gradually to construct. As they master the words and sentences of the primer, they gain the power to learn

other words containing similar vowel and consonant elements, so that their vocabulary may easily grow beyond the limits of this little volume. In the same way, these sentences lead to the construction of others, and prepare the child for more advanced lessons in language.

The illustrations are simple but numerous, in order to facilitate the all-important association of words and phrases with the objects for which they stand.

It need not be said that deaf children, especially the little ones, meet many difficulties unknown to those who hear. Because they do so, they need a different primer from any in use among the hearing, and it is out of the actual necessities encountered in teaching the deaf, and the actual means by which they have been met in the Horace Mann School, that this primer has grown. The hope is entertained that teachers of the deaf in other schools will find their labors assisted by the methods that have proved helpful in the school where they originated.

Nor should our desire that this book may be serviceable confine itself to the teaching of the deaf. Hearing children, it is hoped, may be helped by it in their first lessons wherever the common primer may be found unsuited to them. Like all other text-books of any real value, its purpose is comprehensive.

I have much pleasure in writing this preface at Miss Fuller's request.

SAMUEL ELIOT.

July, 1888.

Practical Lessons in the Use of English.

For Primary and Grammar Schools, By MARY F. HYDE, Teacher of Composition in the State Normal School, Albany, N.Y. Cloth, 158 pp. Introduction price, 35 cents. Second Book, 238 pp. Introduction price, 50 cents. Supplement, 124 pages, 30 cents. Second Book with Supplement, 362 pages, 60 cents.

THIS series consists of two books. The first part of the First Book contains such exercises as are needed by pupils when they first begin to write English. It also includes reproduction exercises, picture lessons, dictation exercises, choice selections for memorizing, practice in letter-writing, etc. The second part of the book is for a more advanced grade.

The Second Book is intended for pupils in grammar schools. It covers such technical grammar as is essential to a correct use of the language, gives many selections for study from the best writers, the most common uses of capital letters and of marks of punctuation, practical exercises in composition, and special instruction in writing letters, invitations, advertisements, public notices, etc.

Among the distinctive features of this series are the following:—

1. Every topic introduced for study has a practical bearing upon the pupil's own use of English.

2. A definite fact is presented in each lesson, and the pupil is led to apply that fact before taking up another lesson.

3. The pupil's powers of observation are cultivated at every step. He is trained to think clearly and independently.

4. The study of the selections given aids the pupil in forming a taste for good literature.

5. The Written Exercises afford daily practice in using the knowledge acquired, and lead the pupil to form habits of independent work.

6. The exercises in composition are not exercises in mere sentence-making. They are exercises in the expression of thought. The pupil is led to think clearly and definitely upon the subject given, and to express his thoughts simply and naturally.

7. Special prominence is given to letter-writing, and to written forms relating to the ordinary business of life.

8. The exercises are carefully graded throughout, and frequent and comprehensive reviews are given.

9. The work will aid teachers as well as pupils. It is so arranged that even the in experienced teacher willhave no difficulty in awakening an interest in the subjects presented.

The following Commendations have been received from those NOW USING the books:—

Thomas Tash, *late Supt. of Schools, Portland, Me.:* We have been using constantly, twenty minutes *every day*, Miss Hyde's "Lessons in English" in our classes, 4th, 5th, and 6th years in school, the children all being provided with books. We shall probably next year make it a guide in class-work in Language one year earlier.

I gladly add that the teachers using the book are greatly pleased with it and the results secured in its use.

As I hear the lessons given by them I am equally satisfied. (*April* 16, 1889.)

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